Power Engineering

SEPTEMBER, 1953

Volume 57, No. 9 Circulation of this issue 32,480

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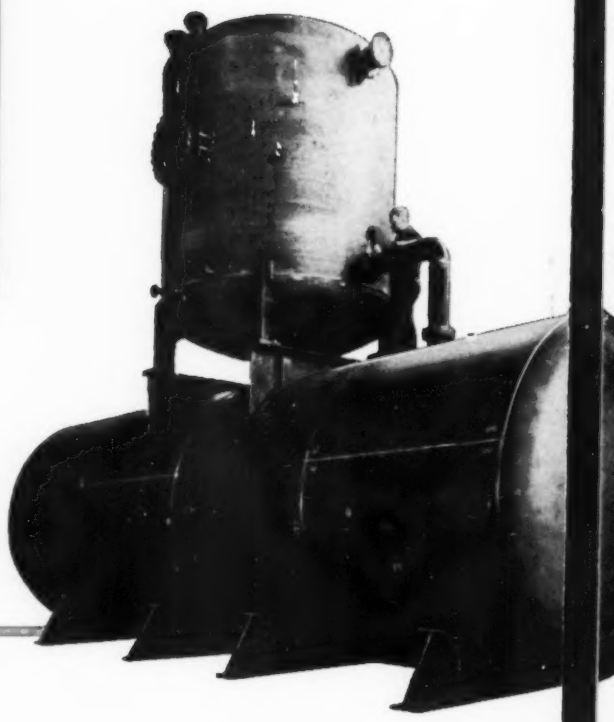
Assembly line in Elliott Company welding shop.

THE LATEST DESIGN *of Elliott deaerating heater incorporates this stainless steel vent collecting hood, which with the inlet spray assembly is located inside the shell at the top. This replaces the former tubular vent condenser located outside the shell in older designs, requires no maintenance beyond occasional inspection, and simplifies headroom problems.*

At right, a 975,000-lb-per-hr Elliott vertical deaerating feedwater heater, mounted on its storage tank, set up for final testing in the Elliott shops. A notable feature is that stainless steel is used throughout wherever there is contact with corrosive water. This includes the trays which are of fabricated stainless steel and light in weight.



deaerating heaters
ELLIOTT
does the whole job!

Users of Elliott deaerating heaters enjoy the assurance that the entire construction of each unit is Elliott shop-built all the way through. No responsibility for any part of the construction is delegated to an outside organization. Elliott quality is rigidly maintained right from the bending of the first plate to the welding of the last inch of joint. The entire unit is set up, hydrostatically tested, dismantled, and loaded on flatcars for shipment. At no time has the heater or any part of it, been outside the Elliott plant.

For full details on Elliott deaerating heaters, contact your local Elliott representative or write Elliott Company, Jeannette, Pa.

ELLIOTT Company

N3-1

DEAERATOR AND HEATER DEPARTMENT

For more data circle 501 on Post Card

How to Figure the cost of STEAM TRAPS

1. PRICE—you get a lot of trap for your money when you buy an Armstrong: big capacity in small size; the long-lasting mechanism in traps for low and medium pressures is identical in design, workmanship and materials, to that in traps for 900 degrees, 950 lbs. pressure!

2. INSTALLATION—Armstrong gives you a choice of body styles to save installation labor and pipe fittings.

3. MAINTENANCE—Armstrong traps last longer! You save labor, parts cost and downtime. Freedom from leakage saves fuel.

Divide total trap cost by the life of the trap to get *costs per year*—this is where Armstrong traps really shine. Call your Armstrong Representative for the traps you need now, or write:

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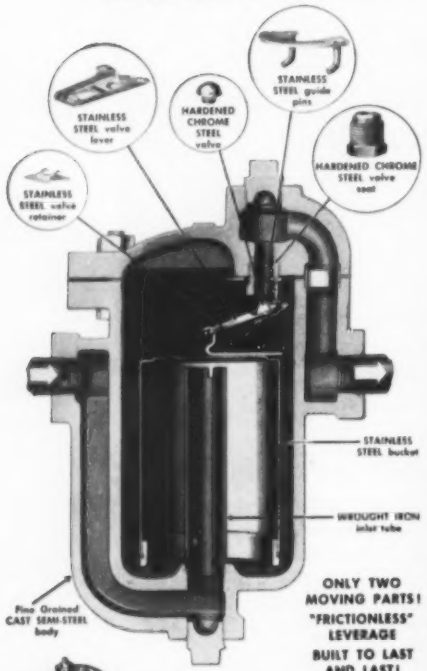
810 Maple Street • Three Rivers, Michigan

Full Facts In FREE Catalog J

Catalog J, also an educational handbook on condensate drainage, gives sizes, prices and capacities of Armstrong traps. It tells how to select traps; how to make hook-ups; how to trouble-shoot. Send for a copy today.


STAINLESS STEEL valve lever
HARDENED CHROME STEEL valve
STAINLESS STEEL guide pins
HARDENED CHROME STEEL valve seat
STAINLESS STEEL valve retainer
STAINLESS STEEL bucket
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Fine Grained CAST SEMI-STEEL body
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"FRICTIONLESS" LEVERAGE
BUILT TO LAST AND LAST!

STEAM TRAP CHECK LIST	ARMSTRONG TRAPS
Hardened chrome steel valve and seat?	Yes
All other parts stainless steel?	Yes
Long-lasting "frictionless" leverage?	Yes
Self-cleaning, non-clogging operation?	Yes
Choice of body styles?	Yes
Available with built-in strainers?	Yes
Available with internal check valves?	Yes
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Guaranteed *unconditionally* to satisfy?	Yes

ARMSTRONG STEAM TRAPS COST LESS!

For more data circle 502 on Post Card

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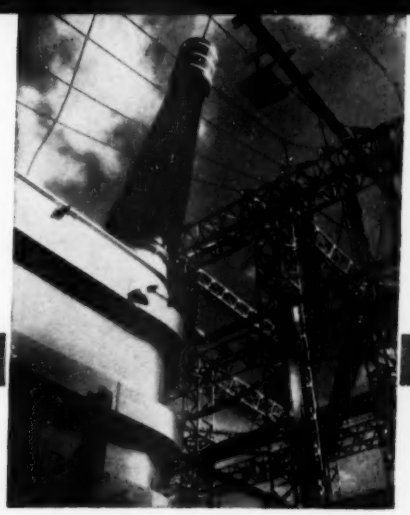

Voltages up to 440 kv are developed by this transformer at GE's switchgear testing plant

Power Engineering

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The only magazine devoted exclusively to the job interests of power engineers

Oh, I see

OIC VALVES at work in the power plant at Ford Motor Company.

THE CLEVELAND PLANT of the Ford Motor Company, showing the engine plant, foundry and power plant.

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For more data circle 503 on Post Card

ENGINEERS' PREVIEW

NOW THEY TELL US! After 35 years of making a living — sometimes good, sometimes bad — as a technical writer and editor, we now find we should have waited and taken the newly established graduate course at Rensselaer Polytechnic Institute, leading to a degree of master of science with a graduate major in Writing. Seriously, we heartily approve and wonder if maybe we shouldn't take it after all and try to get that master's degree, for the valuable bachelor's degree we got 35 years ago has now become a dime a dozen. Wonder what we'd look like in a cap and gown going up to get it — at our age?

Rensselaer has also conducted recently what seems to be a most practical and interesting technical writer's institute. This is an extension service for writers in business and industry.

* * *

ELGIN B. ROBERTSON, of Dallas, Tex., was elected president of the AIEE at the Summer General Meeting of the Institute in June at Atlantic City. He took office as of August 1.

* * *

FIRST COMPARISON seminar ever held on organic bonding is scheduled for early Fall by the Eutectic Welding Alloys Corp. at its training institute in Flushing, N. Y. The seminar will continue for four days, is open to all who wish to investigate the adhesive bonding of materials and should prove valuable to design engineers, production men, and all who have problems in bonding.

* * *

IDEAS for technical development serve no one until they are put to work. But it frequently is difficult for a free-lance inventor or for research workers in universities and industry to do this. Occasional worthy ideas are conceived that are outside the immediate interest of the laboratory, yet are lost unless they can be developed. Corporations, as well as individuals, may lose opportunities by letting ideas lie idle.

However, an interesting organization, The Battelle Development Corp., has been established for putting such ideas to work. It is a wholly owned, not-for-profit subsidiary of Battelle Memorial Institute. It provides the mechanism for developing and commercializing inventions that might otherwise be lost to mankind, because of an inventor's lack of funds, and at the same time creates funds for financing further research at Battelle. This organization is described completely in a 16-page bulletin entitled Putting Ideas to Work and, if you are interested in getting a copy of it, let us know and we'll see that you do. Write to *Engineers' Preview* editor.

* * *

H. H. GORRIE, assistant chief engineer of Bailey Meter Co., has been appointed chief engineer, directly in charge of the company's engineering activities. Gorrie, who started with Bailey Meter Co. in 1927, became assistant chief engineer in 1944. He is a graduate of Rensselaer Polytechnic Institute, a registered professional engineer in Ohio, and active in the ASME, the ASTM, the Scientific Apparatus Makers Association, and the Cleveland Engineering Society.

REMEMBER our old friend *Mytilus Edulis* — in short, the bay mussel that collects in salt cooling water conduits, plugs up condenser tubes and gets all over the condenser tube sheets, causing shutdowns, long hours of overtime cleaning work, to say nothing of the terrible smell? Well, you can suffocate 'em to death.

Several ways have been tried to kill these and other marine growths in coast-wise plants, such as raising the water temperature by recirculation, or chlorination of the circulating water. These two have been found extremely satisfactory in many cases.

But in the Harbor Steam Plant, as reported in ASME paper number 53-SA-18, the first method was impracticable and the chlorination system too costly. So they used what is called anaerobic treatment.

They sealed off the east conduit for seven days, rapidly decreased the dissolved oxygen concentration and increased the hydrogen sulphide; and then, on opening the tunnel, they found that over 45 tons of dead marine life were washed out of the conduit into the discharge basin. In effect, they choked *Mytilus Edulis* to death, because the organisms consume oxygen and within a certain period will reduce the dissolved oxygen to some low value below which they cannot survive. In later experiments, they added sodium sulphite to the water to shorten the time required for oxygen depletion.

More than one way to skin a cat, huh?

* * *

TRANSMISSION at 500,000 v is not too far away, according to J. F. Sinnott of San Diego Gas and Electric Co., speaking before the Pacific Coast Electrical Association recently. It might be well, he said, to design and construct present lines to operate at higher voltages than those used initially. Transmission of large blocks of power, over long distances, may have to employ entirely new principles. Mr. Sinnott discussed designs embodying electrostatic or electromagnetic means of confining the energy to the conductor. He predicted that transmission lines of the future will be relatively simple buried pipes, compared to modern underground cables and will not have to rely upon the bulky and costly dielectric materials used today.

* * *

W. TOM MOORE has been named an executive assistant in the Atomic Power Division of the Babcock & Wilcox Co. He has been with B&W since 1926, shortly after his graduation from the U. S. Naval Academy and has been engaged in development and design work for the company during most of this period. In 1946 he was assigned to Oak Ridge National Laboratory and in 1948 was transferred to the Argonne National Laboratory, where he assisted in development of a submarine power plant to operate with atomic fuel (see POWER ENGINEERING, June 1953 issue).

* * *

RICHARD C. BOOTON, JR. has won the Institute of Radio Engineers 1953 Award for his paper entitled "An Optimization Theory for Time-Varying Linear Systems with Nonstationary Statistical Inputs".

Huh? Whazzat?

BATTELLE In Europe will be a new development to watch in research. Battelle Memorial Institute of Columbus, Ohio, is establishing a new research center at Frankfurt/Main in Germany to serve the industry of that country. A cornerstone for the new research center was scheduled to be laid recently. It was simultaneously announced that Battelle is establishing another research center at Geneva, Switzerland and has set up a program of fellowships for selected students in the Universities of both Switzerland and Germany. In addition research centers and fellowship programs for other countries of western Europe are contemplated for the future. The Frankfurt research center will engage in chemical, metallurgical and engineering research.

* * *

A SPADE is a spade is a spade is a spade, as Gertrude Stein might have said. Then too you probably have been advised to call a spade a spade and not a blank blank of a blank shovel. But there can be some pretty special kinds of spades, like the titanium spade used to break ground for the new Westinghouse Research Center in Pittsburgh recently. The spade symbolized the great strides made through industrial research.

Four short years ago, the metal was almost unknown in metallic form, but under various incentives, many years of normal development have been telescoped and Westinghouse now uses alloyed titanium in jet aircraft engines and in some marine applications. They promise it will have many other future applications where strong, light material is needed.

* * *

WE DO NOT KNOW what is meant by tear sheets, but since we shed many a tear we are willing students," was a comment written on the bottom of a recent return postal card from POWER ENGINEERING. It was at the bottom of the card, where it says "Use this space to ask for tear sheets and other information." It came from a plant built in a foreign country by a famous American company. Is there really a difficulty with the language here, or are we being kidded by not-so-experts?

* * *

STANDARDIZATION of industrial materials, parts and production is one of the few remaining means to combat problems created by the present upward spiral of wages, production costs and increased production capacity in the United States. So said Roger E. Gay, president of the American Standards Association, addressing the Annual Convention of the National Association of Purchasing Agents.

* * *

GERMANIUM is the scarce metal that goes into the magic new electronic transistors which have been widely publicized in the nation's science press. Their many possible uses has naturally led to a determined hunt for sources of germanium because, today, it sells for $350 a pound. A new discovery, however, may solve the problem.

Geologists say that coal has the property of extracting germanium from water or gases that come into contact with it. For this reason, the Pennsylvania Coke and Coal Corp. recently asked coal operators all over the Appalachian coal region to send in samples of coal for germanium assay.

TINY GLASS BALLOONS, about the size of grains of sand, constitute a new construction material with many potential applications in the building trade, according to a ceramic expert at Armour Research Foundation of Illinois Institute of Technology, where it was developed.

Trade-named "Kanamite" after the company that sponsored the development work at the Foundation, the material is a fine-grain lightweight aggregate made by blowing up individual grains of clay in a special furnace. Concrete mixes using the new material in place of sand or other aggregates are very fluid, even though water content is low. This means, for the first time in building history, that contractors can fill forms with concrete pumped through rubber hoses. Hence construction costs can be lowered because of the virtue of replacement of shovels and awkward metal hose now used.

Concrete, mortar and plaster made with the material have proved to be strong and light and to have good insulating qualities, it is stated by the Foundation. Center coatings of plaster are possible, also thinner plaster board, and it is planned to use it in making lightweight refractories and high temperature insulating materials.

* * *

ROBERT J. STORMONT, vice-president and general manager of Wickes Boiler Co., a division of Wickes Corp., Saginaw, Mich., has been named chairman of a newly organized Saginaw Valley Sub-Section of ASME. The group was organized to accommodate Detroit Section members living in the Saginaw, Bay City, Midland area of Central Michigan. Max Riebenack, sales manager of Industrial Brownhoist Corp., was elected vice-chairman of the new sub-section.

* * *

FRANK X. GILG has been appointed an executive assistant in the boiler section of the Babcock & Wilcox Co. Mr. Gilg joined B&W in 1922 as a draftsman at Bayonne and became a design engineer, moved to the service department in 1930, and was made a staff engineer in 1945, and application engineer in 1948. He is author of several technical articles, holds patents on various boiler and furnace detailed designs, is active in the Boiler Code Committee of the ASME, and member of several other engineering societies.

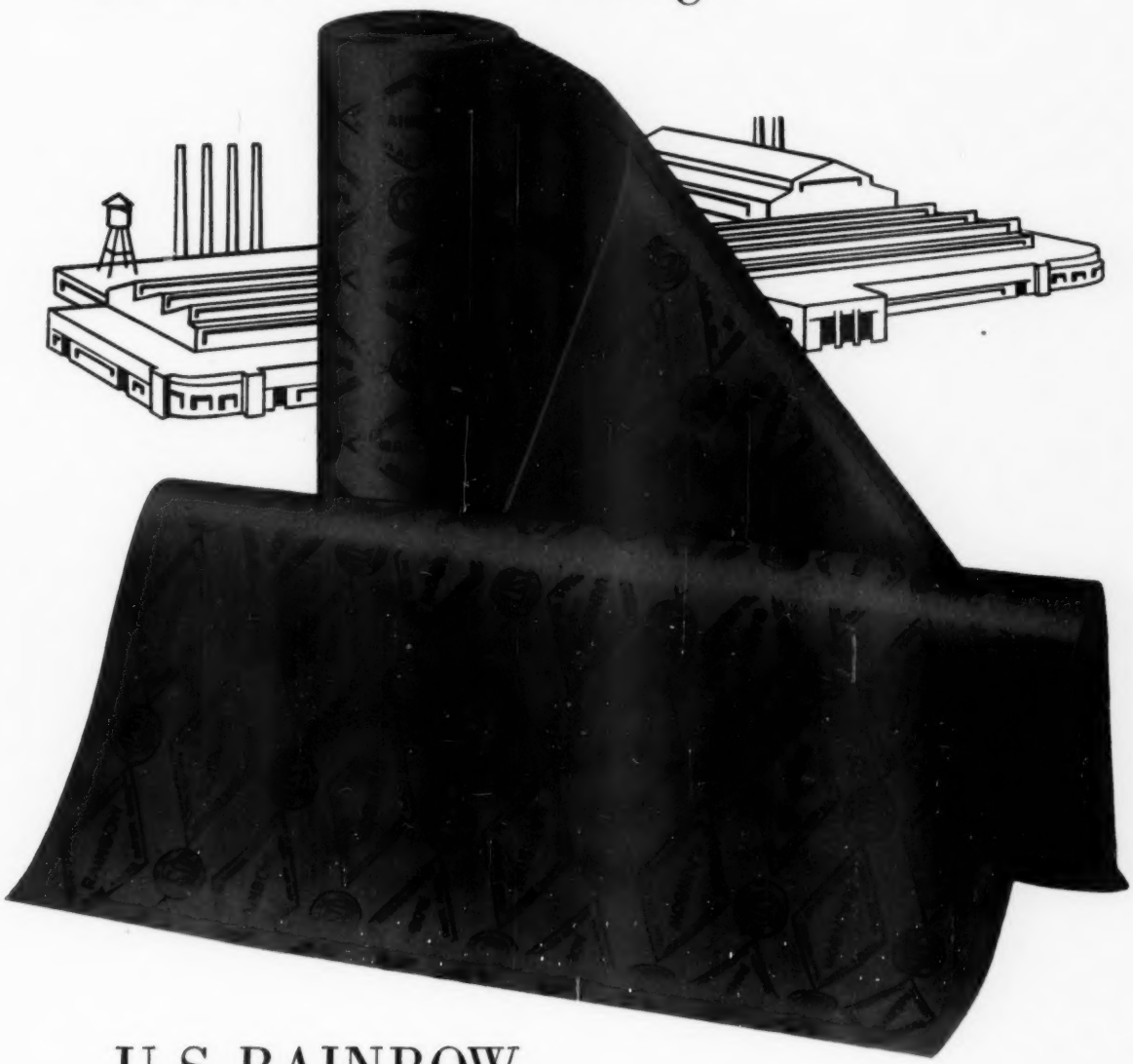
* * *

DOCTOR ATOM is a very lively and remarkable character who has taken it upon himself to explain the development of atomic science to the general population, in non-technical terms they can understand. He does this quite successfully in a most entertaining and practical motion picture called "A is for Atom," produced by General Electric Co. It is now being shown to various industrial groups and in some general movie houses around the country.

The doctor is the central character around whom the activities and characters of the various families of atoms revolve. Their combinations of neutrons and protons are shown in cartoon-type characters. Especially interesting is the single neutron in a bottle — but you have to see that to appreciate it.

This movie is a 16-mm film in color, and prints of it can be borrowed without charge, we understand, from your nearest General Electric Co. regional headquarters, for showing at a school, club or other group.

First in Red Sheet Packings!



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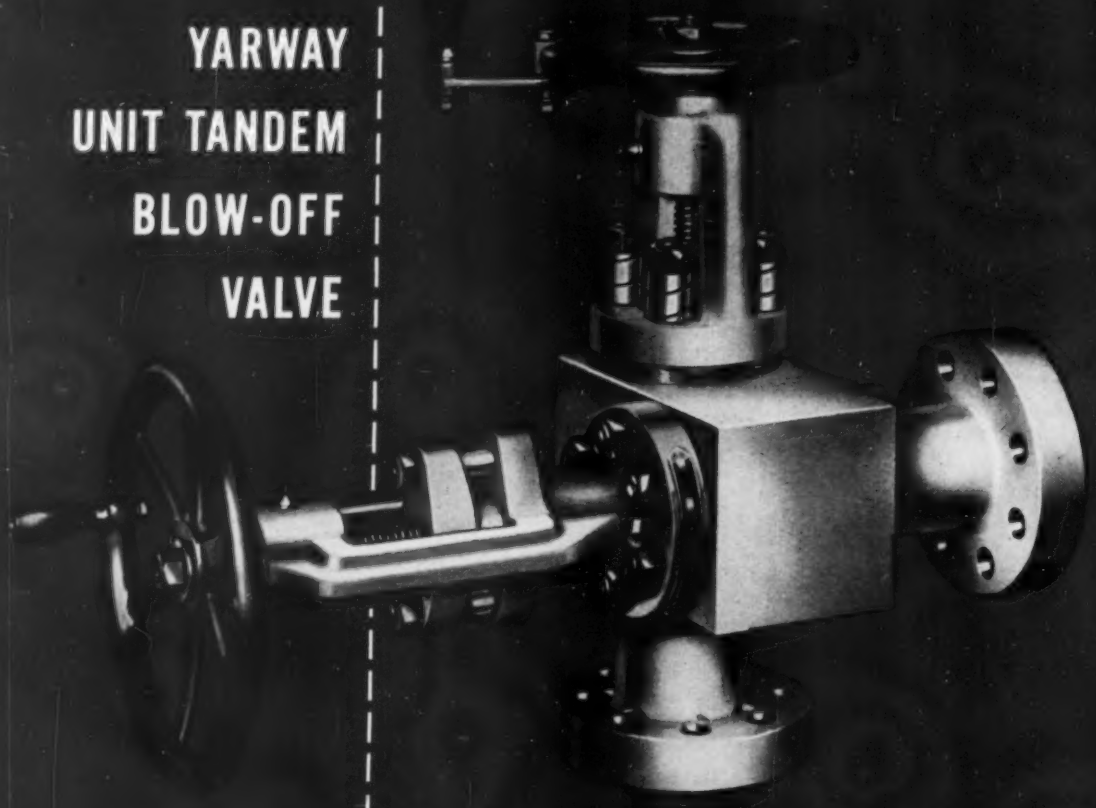
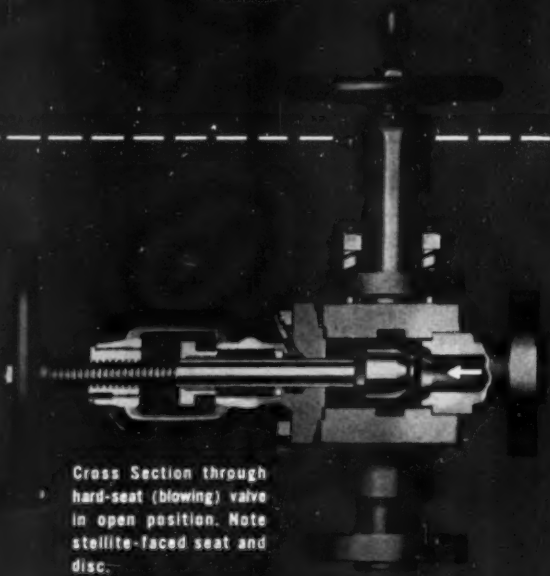
YARWAY UNIT TANDEM BLOW-OFF VALVE

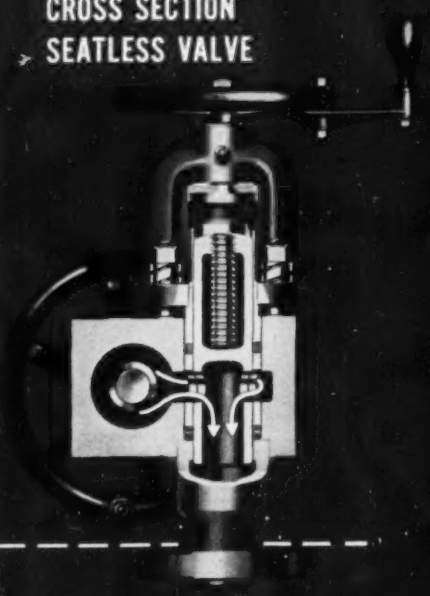


CROSS SECTION HARD-SEAT VALVE



Cross Section through hard-seat (blowing) valve in open position. Note stellite-faced seat and disc.

CROSS SECTION
SEATLESS VALVE



Cross Section through seatless (sealing) valve in open position. (On pressures over 1500 psi two hard seat valves are recommended.)

RUGGEDNESS
...WHERE YOU NEED IT

A one-piece forged steel block serves as the common body for both valves in Yarway Unit Tandem Blow-Off Valves.

You get rugged strength where you need it... added protection for your high pressure boilers.

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When putting high pressure boilers on the line, or in times of emergency, you need positive action at the blow-off valves.

With Yarways you have it.

Both the hard seat-seatless combinations and the hard seat-hard seat combinations provide positive opening and closing with drop-tight shut-off. Open yokes permit visual indication of the disc position in the hard seat valve and of the plunger in the seatless valve.

These are some of the reasons why *more than 4 out of every 5 high pressure plants in the United States are Yarway-equipped . . and* among boiler plants of all pressures, *more than 16,000 are Yarway-equipped*

Write for your free copy of Yarway Blow-Off Valve Bulletin B-425 (pressures to 400 psi) or Bulletin B-433 (pressures to 2500 psi).

YARNALL-WARING COMPANY
114 Mermaid Avenue, Philadelphia 18, Pa.

YARWAY®

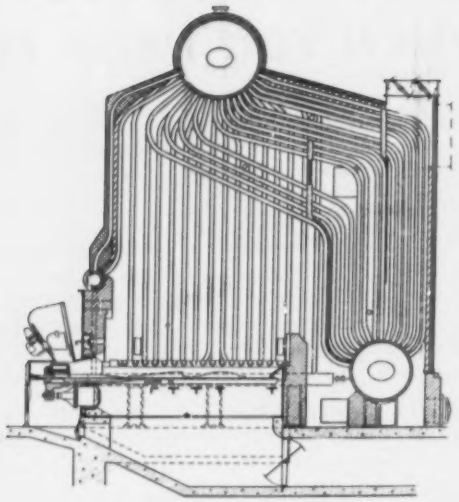
blow-off valves

For more data circle 505 on Post Card

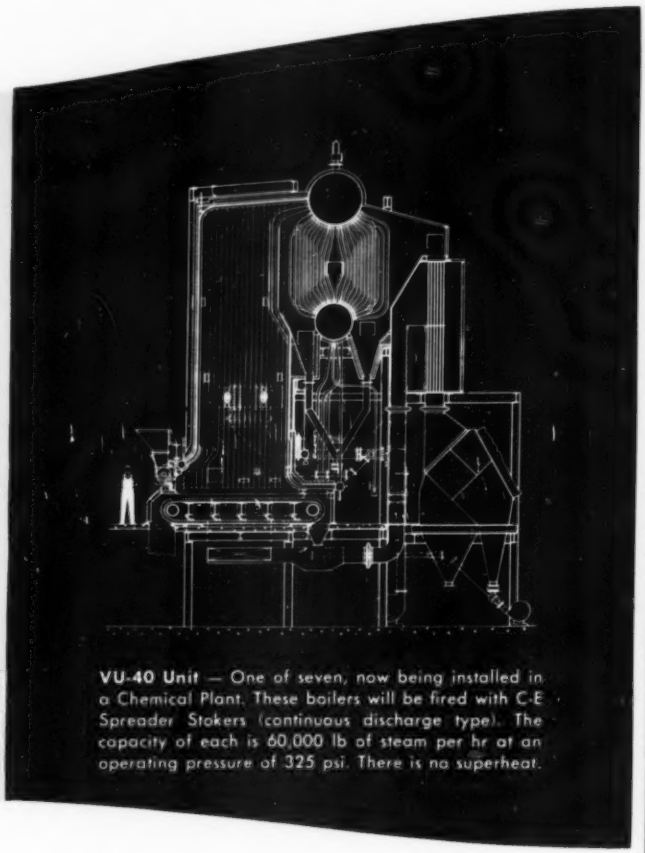
VU Utility Standards

Electric utility companies maintain the highest equipment standards in the power generation field. Kilowatts are their business — their product . . . to be turned out reliably, efficiently and at the lowest possible cost. To assure this they demand — and get — the most reliable — the most efficient — the best built boilers that the market affords.

To meet their highly critical standards the utilities have long been accustomed to purchase steam generating units that were, in large measure, individually designed to meet their particular needs.



VU-10 Boiler — This unit is installed in a hosiery mill. It is fired by a Type E Underfeed Stoker. Capacity — 12,500 lb steam per hr; operating pressure — 100 psi; no superheat. VU-10 Boilers are available in sizes from 10,000 to 60,000 lb of steam per hr.



VU-40 Unit — One of seven, now being installed in a Chemical Plant. These boilers will be fired with C-E Spreader Stokers (continuous discharge type). The capacity of each is 60,000 lb of steam per hr at an operating pressure of 325 psi. There is no superheat.

COMBUSTION

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT

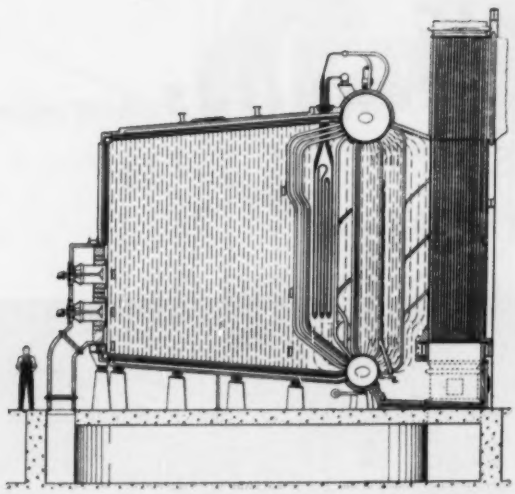
in a Standard Boiler

And C-E Vertical-Unit Boilers, particularly in the larger sizes, are available in "custom-made" designs to suit specific requirements. In fact, VU Units have been a popular choice with utility companies for many years.

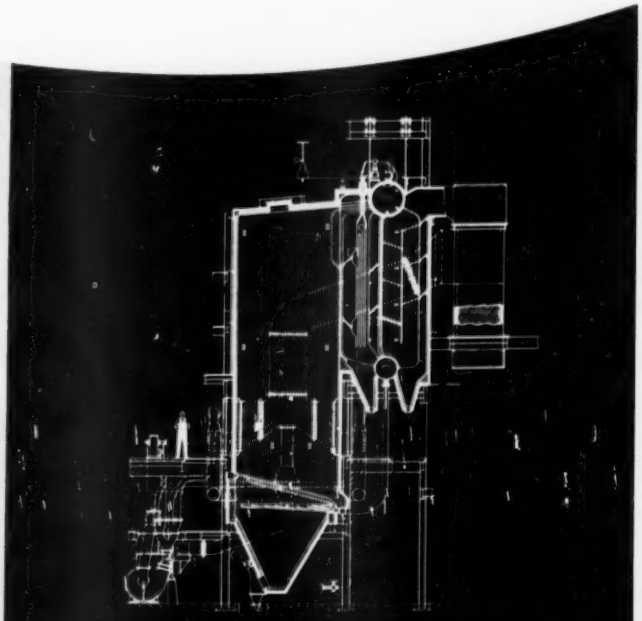
But many other designs that comprise the "VU family" are completely *standardized* . . . standardized without sacrifice of "custom-made" advantages. And when you standardize you reduce engineering costs, reduce manufacturing costs, reduce erection costs — in short, you save money.

Here then is a line of custom-quality boilers with all the benefits of standardization built in capacities from 10,000 lb of steam per hr up, for any pressure and temperature . . . and suitable for any type of fuel burning equipment.

Little wonder that industry — all industry — has found within the VU family a boiler unit exactly suited to its needs. Breweries and hosiery mills, chemical companies and steel plants — all have installed VU Boilers again and again with complete satisfaction. So can you.



VU-50 Boiler — This unit is one of two duplicates installed in a brewery. They are fired with oil or gas. Capacity — 100,000 lb of steam per hr; operating pressure 550 psi; steam temperature 700 F. This particular design is of the bottom-supported type.



VU-50 Boiler — This unit, one of five duplicates, is in service in a large tube mill. It is designed to burn pulverized coal and blast furnace gas. Capacity — 175,000 lb steam per hr; operating pressure — 850 psi; steam temperature 750 F.

ENGINEERING, Inc.

Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y.

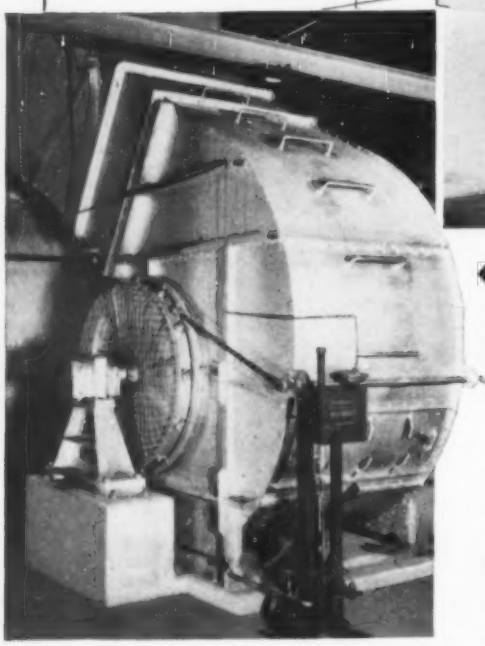
C-E

B-649

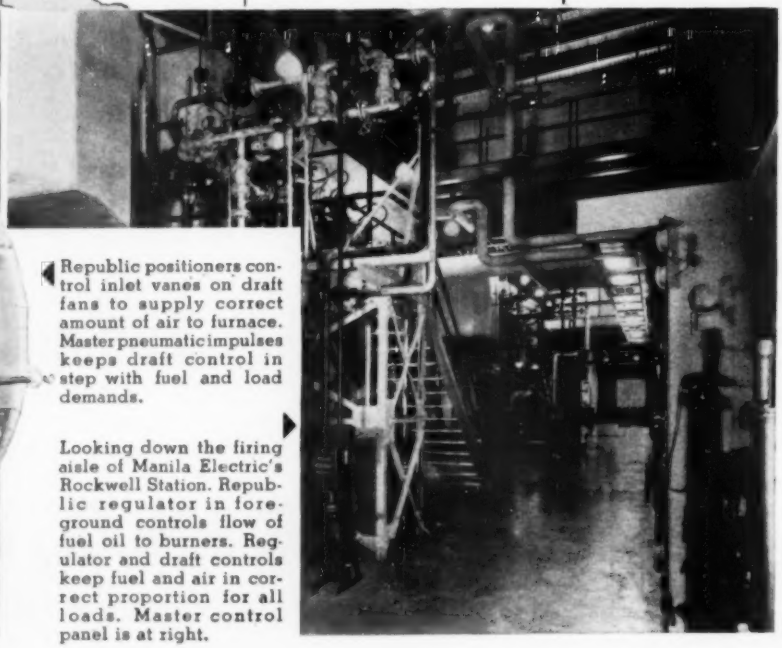
For more data circle 506 on Post Card

IN THE PHILIPPINES . . .

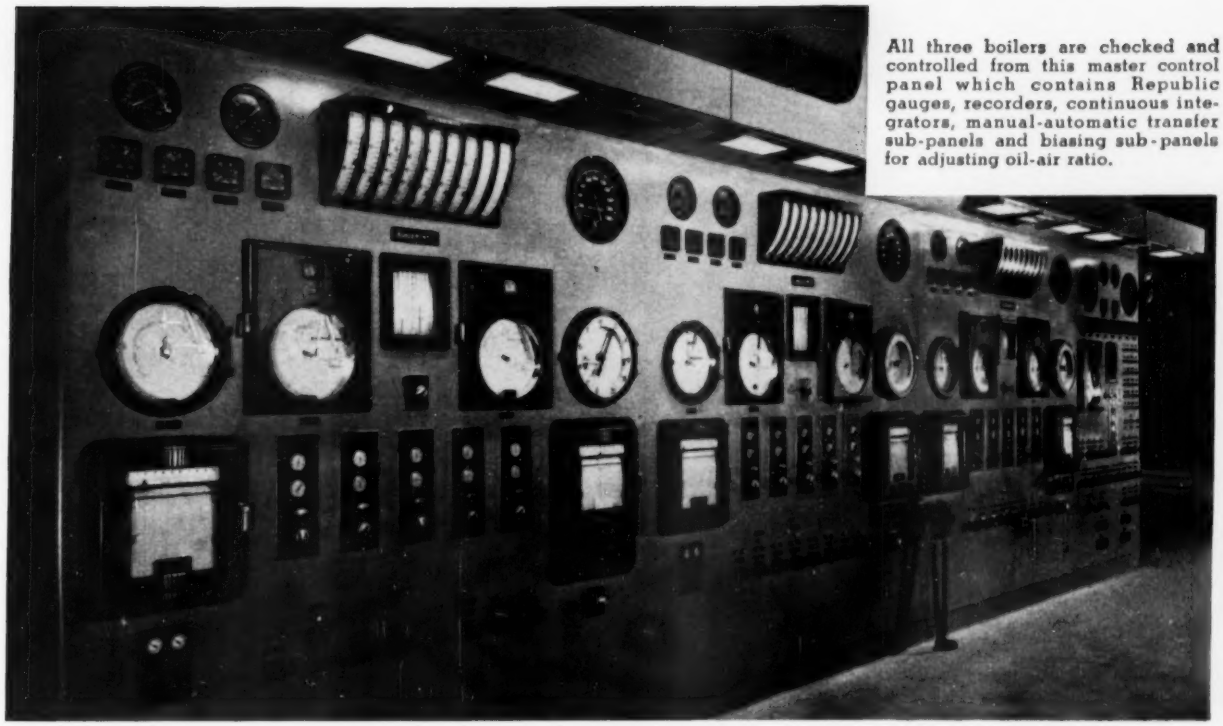
MANILA ELECTRIC Rebuilds . . . .



Republic positioners control inlet vanes on draft fans to supply correct amount of air to furnace. Master pneumatic impulses keeps draft control in step with fuel and load demands.



Looking down the firing aisle of Manila Electric's Rockwell Station. Republic regulator in foreground controls flow of fuel oil to burners. Regulator and draft controls keep fuel and air in correct proportion for all loads. Master control panel is at right.



All three boilers are checked and controlled from this master control panel which contains Republic gauges, recorders, continuous integrators, manual-automatic transfer sub-panels and biasing sub-panels for adjusting oil-air ratio.

installs **REPUBLIC** *Automatic*

COMBUSTION CONTROLS to get maximum combustion efficiency

1945. Manila is a shambles. Rebuilding of pre-war power equipment starts. But power demands skyrocket. It's necessary to bring in a floating 30,000 kw power station to meet the emergency. Electrical demand grows until it is even more than pre-war power facilities can handle. Distribution transformers must be worked until the insulating oil boils; sub-station transformers must be constantly cooled with a water spray; wires turn cherry red because the overloads are so great.

That was the Manila power situation after the war. Now, Manila Electric Company, who had to meet this demand, is over the "hump." One big reason is its modern new power station which is capable of generating 50,000 kw. Designed by Gilbert Associates, Inc., it contains three oil-fired boilers, each rated at 250,000 lbs. per hr. at 875 psig and 910° F. To maintain the operation of these boilers at maximum efficiency under all load conditions, Republic Automatic Combustion Controls have been installed. Pressure reducing valves and controls plus feedwater pump controls were also furnished by Republic.

This is but one example of power stations all over the world that are equipped with Republic Combustion Controls. Recent over-seas installations include stations in Italy, Greece, Chile, India and Australia.

Wherever the station, whatever the fuel, draft arrangements or load characteristic, Republic Combustion Controls can operate boilers to hold fuel and air in the correct amounts and proportion for maximum combustion efficiency.

Get the details in Data Book S-21 or contact your nearby Republic field engineer.

REPUBLIC FLOW METERS CO. ● 2240 DIVERSEY PARKWAY • CHICAGO 47, ILLINOIS

For more data circle 537 on Post Card

ONLY UNDER DIRECT FLAME, will GE's new self-extinguishing insulation for metal-clad switchgear char—as demonstrated in this picture with flame of blow-torch applied directly to the new laminated sheet-type insulation.

GE's "self-extinguishing" insulation gives

New sheet-type material with exclusive, flame-retardant feature localizes damage that may occur under abnormal conditions

The equivalent of a "built-in fire extinguisher"—a flame-retardant insulation for switchgear, marks the most recent General Electric development for even safer, more dependable metal-clad switchgear—industry's standard for 2400- to 13,800-volt circuits.

In introducing this flame-retardant insulation—which was perfected by Nicholas F. Arone, engineer in its Switchgear Department in Philadelphia—G.E. has gone far to minimize all potential fire hazards in switchgear.

All good insulating material has three standard properties: high mechanical strength, high dielectric strength, and a non-hygroscopic quality. To this group, G.E. is the first to add an important fourth property: a self-extinguishing characteristic that *refuses to sustain combustion.*

The laminated insulation sheet will burn and char—but *only* if an outside source of flame remains in contact with the sheet itself. Once the source is removed, polyvinylchlorides "smother" the flame in less than a minute—localize damage—and permit quick access to compartments for inspection and maintenance.

In bus and cable supports, in insulating barriers between compartments, in box barriers for arc chutes—throughout vital spots of metal-clad, GE's new flame-retardant insulation works for greater protection under *all* conditions—without extra cost to you.

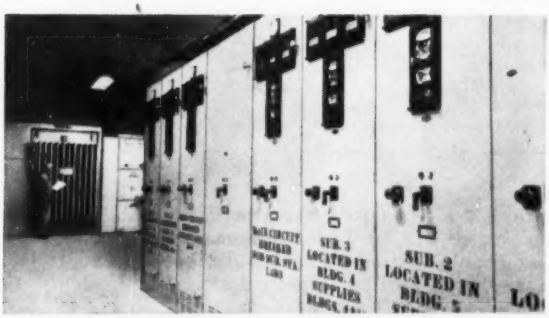
G. E. BURENS, *general manager, Switchgear and Control Division, presents Coffin Award to N. F. Arone for development of outstanding new insulation. Coffin Award is General Electric's highest employee honor.*

For information on improved Metal-Clad Switchgear, with new, flame-retardant insulation, call your nearest G-E sales representative, or write to General Electric Company, Schenectady 5, N. Y. 874-3

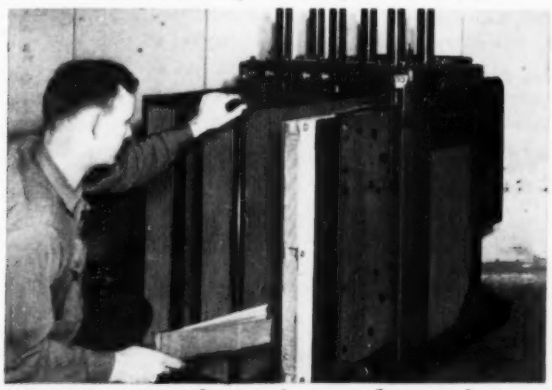
GENERAL ELECTRIC

WITH FLAME REMOVED, the flame-retardant insulation refuses to sustain combustion—and extinguishes itself in less than 60 seconds. Polyvinyl-chlorides in the laminated sheet "smother" the flame, permitting ready access to compartments for inspection and maintenance.

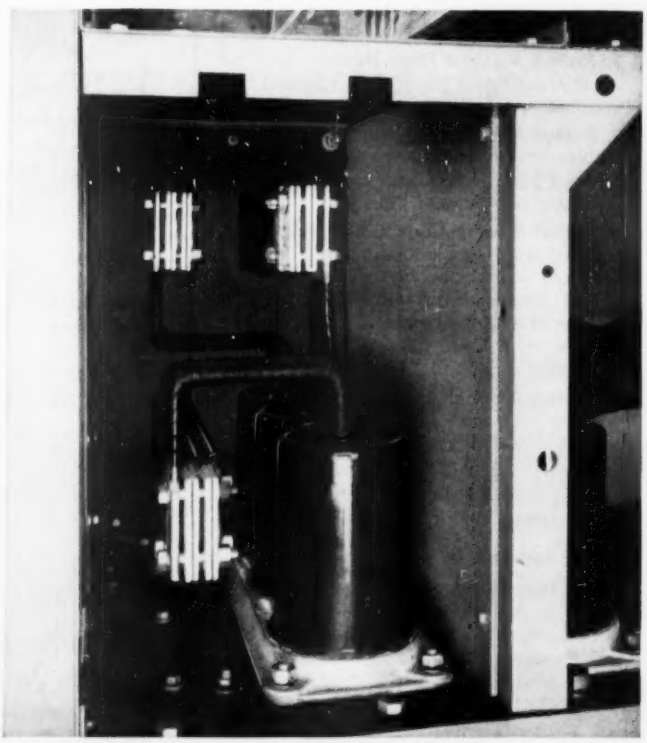
added protection to metal-clad switchgear



THIS METAL-CLAD SWITCHGEAR lineup features GE's new flame-retardant insulation at vital points throughout all sections.



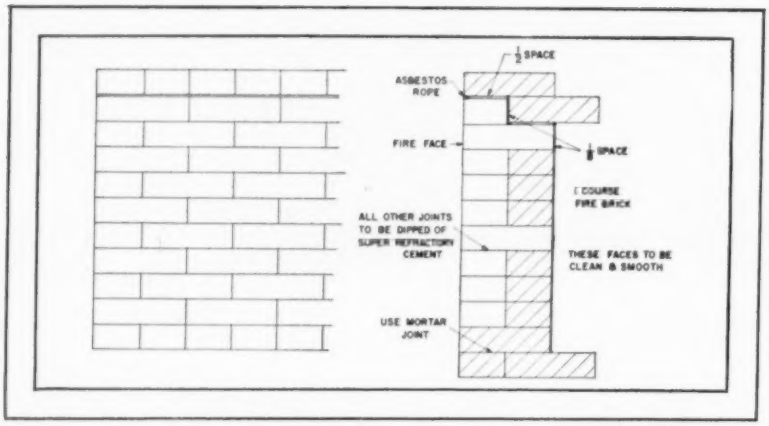
INSULATING BARRIERS for arc chutes are flame-retardant, non-hygroscopic, possess high mechanical and dielectric strength.



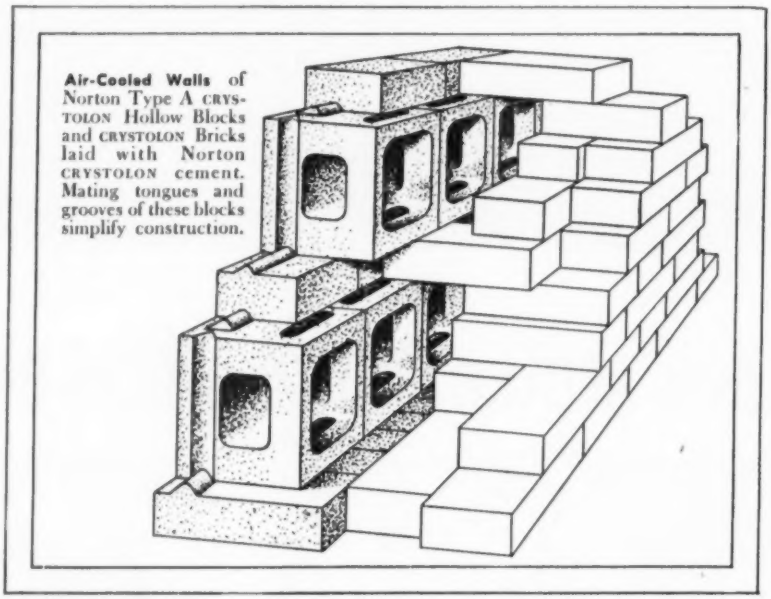
COMPARTMENTIZED SECTIONS, in addition to self-extinguishing insulation as shown in this bus section, limit damage from abnormal conditions.

For more data circle 503 on Post Card

How to form a "safety belt" for your boiler "TROUBLE ZONE"



Solid Wall with up to 9 courses of Norton Company bricks laid with Norton CRYSTOLON cement. For best results, not less than 5 courses of CRYSTOLON brick should be used in any boiler furnace.



Air-Cooled Walls of Norton Type A CRYSTOLON Hollow Blocks and CRYSTOLON Bricks laid with Norton CRYSTOLON cement. Mating tongues and grooves of these blocks simplify construction.

Avoid spalled, eroded or cracked boiler walls. Why lose costly hours during shutdowns for repairs? Instead, use special Norton CRYSTOLON* (silicon carbide) refractory shapes for the furnace "Trouble Zone." They form a protective "Safety Belt" that cuts maintenance interruption to a minimum.

Get four-way protection

You can rely on complete boiler wall protection from Norton CRYSTOLON Refractories because they resist the four most common causes of boiler wall failure:

1. **Protect Against High Heat.** CRYSTOLON Refractories withstand temperatures up to 3050°F.
2. **Protect Against Slag Penetration.** CRYSTOLON Refractories are so dense, they're virtually impervious to slag penetration.
3. **Protect Against Clinker Adhesion.** CRYSTOLON Refractories are practically clinker-proof. So rugged that, even if clinkers do adhere to a limited extent, they can be quickly removed without damage to the refractory.
4. **Protect Against Abrasion.** CRYSTOLON Refractories resist abrasion of moving fire beds of stoker-fired furnaces.

Result, longer life and lower overall costs.

For air-cooled or solid walls

Whether your particular "Trouble Zone" calls for air-cooled or solid walls, you will find a Norton special refractory to fit your particular needs. Both the CRYSTOLON hollow blocks and solid bricks more than compensate for the cost differential between them and ordinary fire brick by their longer service, lower maintenance cost.

You will also find Norton CRYSTOLON* cement highly satisfactory for laying up blocks or bricks. It is a fine-grained CRYSTOLON cement, that matures at very low temperatures, withstands temperatures up to 3050°F and assures a very strong bond.

For further information on Norton refractory brick and cement, ask your Norton representative for Norton Bulletin 618 or write direct to NORTON COMPANY, 618 New Bond St., Worcester 6, Mass. *Canadian Representative:* A. P. Green Fire Brick Co., Ltd., Toronto, Ontario

*Trade-Marks Reg. U. S. Pat. Off. and Foreign Countries

NORTON

Special REFRACTORIES

Making better products. . . to make other products better

NORTON COMPANY, WORCESTER 6, MASSACHUSETTS

For more data circle 509 on Post Card

LADISH *Controlled Quality* ASSURES METALLURGICAL SOUNDNESS

SPECTROGRAPHIC ANALYSIS
One of many comprehensive Ladish laboratory test procedures for assuring reliable performance.

TO MARK PROGRESS

Ladish measures the spectrum to verify chemical composition

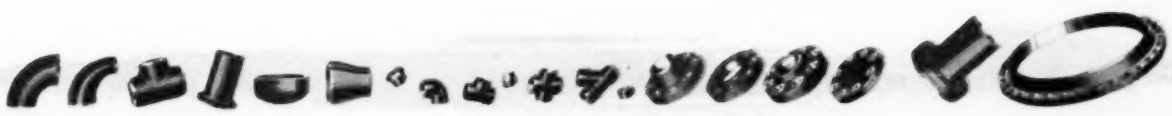
Metallurgical integrity—is safeguarded at Ladish by unsurpassed laboratory controls. Typical is this advanced electronic direct-reading spectrograph. On this unit as many as 300 determinations have been made in one hour to verify compliance of each mill heat with exacting Ladish specifications and, equally important, to assure the absence of detrimental "tramp" elements. Here is but one indication of the thorough, scientific procedures that assure reliability in every Ladish Controlled Quality fitting.

THE COMPLETE *Controlled Quality* FITTINGS LINE
PRODUCED UNDER ONE ROOF . . . ONE RESPONSIBILITY

LADISH CO.

CUDAHY, WISCONSIN
MILWAUKEE SUBURB

District Offices: New York • Buffalo • Pittsburgh • Philadelphia • Cleveland • Chicago • St. Paul
St. Louis • Atlanta • Houston • Tulsa • Los Angeles • San Francisco • Havana • Mexico City • Brantford, Ont.



"I could see the corpsman kneeling over me. The blood plasma was running down through a tube into my arm and he said everything was going to be O.K. I was walking across an enemy mine field in Seoul when one exploded and a piece of shrapnel caught me in the leg.

"'Got enough of that stuff?' I asked him, pointing to the blood. 'I guess we never have enough,' he said, 'but you can thank *somebody* for this pint.'

"How do you thank 'somebody' for blood? For saving your life? When I got back home, I discovered the answer at my local blood donor center. There's only *one* way to say thanks—by giving some of your own blood."

"How do you thank 'somebody' for Blood?"

Yes, all kinds of people give blood—for all kinds of reasons. But whatever *your* reason for giving blood, this you can be sure of: Whether your blood goes to a combat area, a local hospital, or for Civil Defense needs—this priceless, painless gift will some day save an American life!

Business Executives!
✓Check These Questions!

If you can answer "yes" to most of them, you—and your company—are doing a needed job for the National Blood Program.

- ☐ Have you given your employees time off to make blood donations?
- ☐ Do you have a Blood Donor Honor Roll in your company?
- ☐ Have you set up a list of volunteers so that efficient plans can be made for scheduling donors?
- ☐ Have you arranged to have a Bloodmobile make regular visits?
- ☐ Has your management endorsed the local Blood Donor Program?
- ☐ Have you informed employees of your company's plan of co-operation?
- ☐ Was this information given through Plant Bulletin or House Magazine?
- ☐ Has your company given any recognition to donors?
- ☐ Have you conducted a Donor Pledge Campaign in your company?

Remember, as long as a *single* pint of blood may mean the difference between life and death for *any* American . . . the need for blood is *urgent!*

Give Blood Now—Call Your Red Cross Today!

National Blood Program

a teaspoonful of steam!

HERE'S THE ANSWER TO YOUR SMALL FLOW CONTROL PROBLEMS

a NEW LESLIE REDUCING VALVE

for accurate, foolproof regulation of small flows of steam, air, gas or liquids, with inlet pressures to 1000 psi and reduced pressures from 2 to 400 psi.

Change operating conditions quickly and easily with simple, handwheel adjustment —no need to waste time changing springs or swapping parts. Check these widely accepted Leslie features that are standard in the new, efficient, Leslie Small Flow Reducing Valve.

Check these Features

- ✔ Simple, compact construction
- ✔ Top quality materials
- ✔ Metal Diaphragm
- ✔ Entirely enclosed—no stuffing boxes
- ✔ Corrosion resistant springs
- ✔ Hardened stainless steel valve
- ✔ Interchangeable inner valves

SEND FOR DESCRIPTIVE BULLETIN 511-A WITH *COMPLETE* CAPACITY TABLES

Before you order—

The new Class LCB is just one of the many units that are *special* with most manufacturers but are *standard* with Leslie.

Check to see if any pressure, temperature or level control you want is standard with Leslie, before you order. Play it safe. Your Leslie Engineer is listed under "Valves" or "Regulators" in the classified telephone directory in principal cities.

TRADE LESLIE MARK

THE FIRST NAME IN PRESSURE, TEMPERATURE AND LEVEL CONTROLS

Since 1900

LESLIE CO., 301 Grant Avenue, Lyndhurst, New Jersey

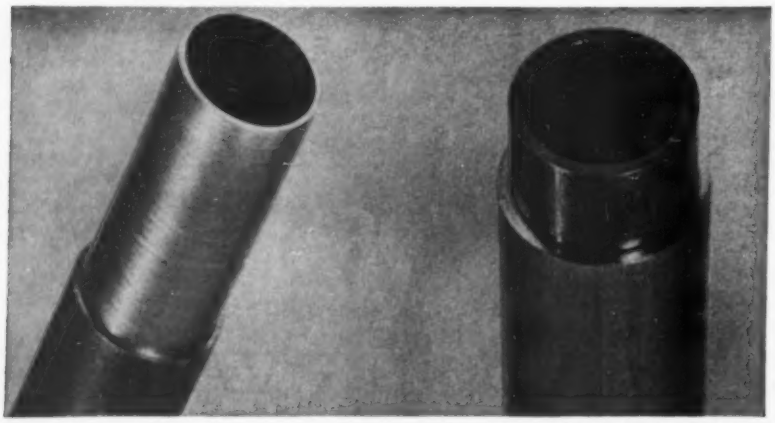
For more data circle 511 on Post Card

BRIDGEPORT BRASS COMPANY

CONDENSER AND HEAT EXCHANGER TUBE EDITION

COPPER ALLOY BULLETIN

Bridgeport Brass Co. MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND. — IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL



Duplex Tubes are double walled—composed of two different metals specially designed to fight both inside and outside corrosion. For example, in ammonia refrigeration systems, steel to the ammonia side and copper or a copper-base alloy to the water or brine side increases heat transfer rate and extends service life with reduced maintenance.

Improving Ammonia Refrigeration Systems With Duplex Tubing

Since ammonia and similar nitrogen compounds are finding greater applications in refrigeration, synthetic chemical compounds and as liquid fertilizers, it is important that we learn how to handle these corrosive gases and liquids.

Dry ammonia gas is not corrosive to most metals and alloys. However, when ammonia is mixed with water and air (oxygen), it severely attacks copper and copper-base alloys.

On the other hand, steels are very resistant to ammonia corrosion. This explains their wide use in the construction of equipment and heat exchangers for producing and handling ammonia and its compounds. The presence of salts such as ammonium nitrate increases the corrosivity of ammonia towards iron, aluminum, zinc, and cadmium.

Ammonia Refrigeration

Corrosion from the water or brine side has always plagued operators of ammonia refrigeration systems. Steel tubes have long been used with ammonia and are satisfactory in withstanding corrosion from the ammonia side, but on the water side rust quickly builds up a heat insulating layer which must be removed from time to time at considerable cost. This is now being overcome through the wider use of Duplex tubes composed of low carbon steel to the ammonia side and copper or copper-base alloys, which stand up well, to the water side.

The most popular Duplex tube combinations are low carbon steel outside and copper, Admiralty, or Red Brass inside towards waters from rivers, lakes, ponds, or wells. When sea water is used for cooling purposes, Duplex Tubing with Cupro Nickel, Duronze IV (arsenical aluminum bronze), Aluminum Brass, and Admiralty are popular. Where high water velocities may cause impingement corrosion, the first three mentioned alloys are superior to Admiralty.

Improved Heat Transfer with Lower Maintenance

Mechanical bonding between the two components of Duplex tubes is so tight that very satisfactory heat transfer characteristics result. The designer can use the fouling factor for copper or copper-base alloys rather than the higher value customarily used for steel. Slime, algae, and marine growths have less tendency to foul copper-base alloys than steel. The use of copper or copper alloys on the water side results in continued high heat transfer characteristics compared to single wall steel tubes whose heat transfer value becomes lower as a thicker insulating coat of rust builds up.

For these reasons smaller size heat exchangers, equipped with Duplex tubes, can be designed to have the same total heat transfer as larger size units with steel tubes. Also, when steel tubes are replaced with Duplex (steel/copper), the improved heat transfer rates result in higher operating efficiency.

An ice company that replaced its steel tubes with Duplex (steel/Admiralty) reported two years later that four semi-annual back-breaking cleanings have been avoided; operating pressures are running 15 to 20 pounds lower; and that their new Duplex tubes have already paid for themselves.

A leak at the tube sheet is dangerous, if not soon corrected, as it may permit sufficient ammonia to contaminate the cooling water or brine, accelerating corrosion of the copper or copper-base alloy component of the Duplex Tubing. Corrosion from contaminated water is most severe at the inlet end of the tubes where turbulence is highest.

Duplex Has Many Advantages

The use of Duplex tubes has increased greatly during recent years because of the following factors:

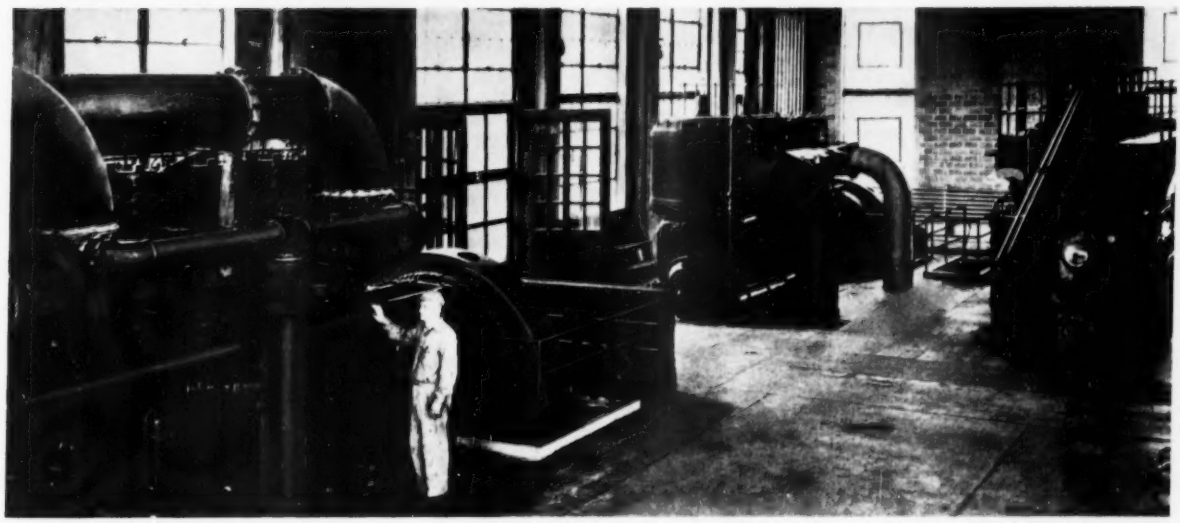
1. They do an excellent job where a dual corrosion problem is involved.
2. Reduce maintenance, shutdown time and labor.
3. Conserve metals since corrosion rates are greatly reduced.
4. Resist corrosion from untreated and treated waters better than steels.
5. Improve heat transfer characteristics or higher efficiency as compared with single-wall ferrous alloys.

If you have a corrosion problem that is difficult to handle, consult our Corrosion Laboratory. It is quite possible that there is a Duplex Tubing combination which is the answer to your problem. Write for the "Duplex Tubing Technical Bulletin No. 1950." (359)

For more data circle 512 on Post Card

H. L. Ostness, Chief Engineer, River Falls Municipal Utility, Wisconsin, says...

"Sticking Rings are no problem in this Plant"



Mr. Ostness, as chief engineer of one of the oldest Municipal Power Plants in Wisconsin, knows diesels – *knows how to get the most out of them.* Mr. Ostness recently wrote, "We have used Sinclair Lubricants for over fifteen years very successfully. GASCON[90] and RUBILENE[91] H.D. have been doing an outstanding job in our diesels. Stuck rings is a trouble we know nothing about – engine wear is at an absolute minimum. With results like these, we'd recommend Sinclair Lubricants any time."

If your present lubricants do less, why not let Sinclair help you get longer life from your diesels – with less trouble. Contact your nearest Sinclair Representative or write Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

SINCLAIR DIESEL LUBRICANTS

save wear and replacement

For more data circle 513 on Post Card

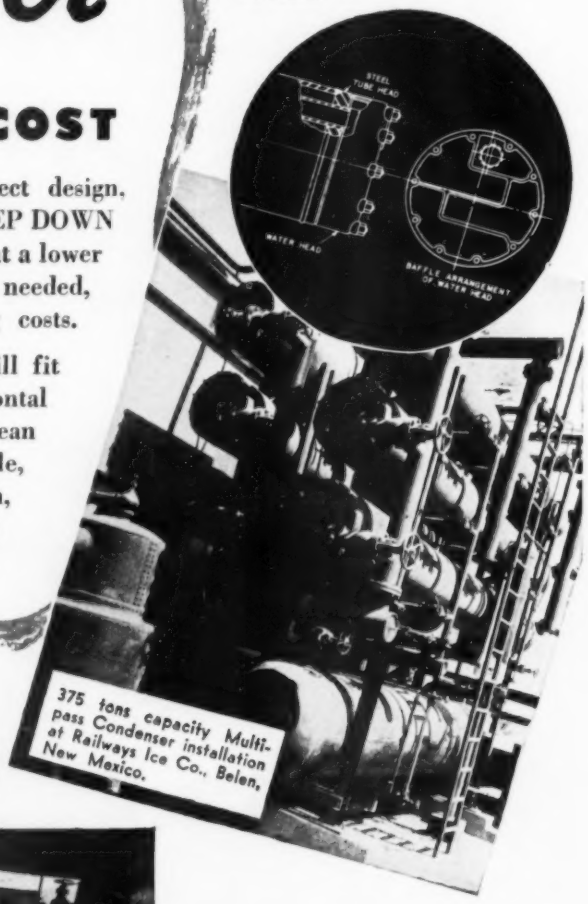
$ave Power and REFRIGERATION COST

Vogt Condensers, because of their correct design, STEP UP the rate of heat transfer and STEP DOWN head pressures. With the liquid delivered at a lower temperature, smaller compressor capacity is needed, saving in original as well as operating costs.

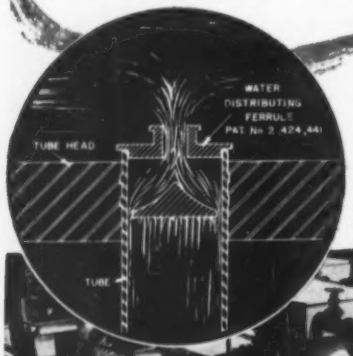
One of the two basic types illustrated will fit your operations exactly. Install Horizontal Multipass (closed type) for use with clean waters. Where the water is hard, forms scale, contains mud or promotes fungus growth, Vertical Single Pass (film type) which can be cleaned in operation, are recommended.

Horizontal Multipass Condensers
(Closed Type)

Water circulated in tubes traverses the length of the unit a number of times as determined by baffles in the heads.

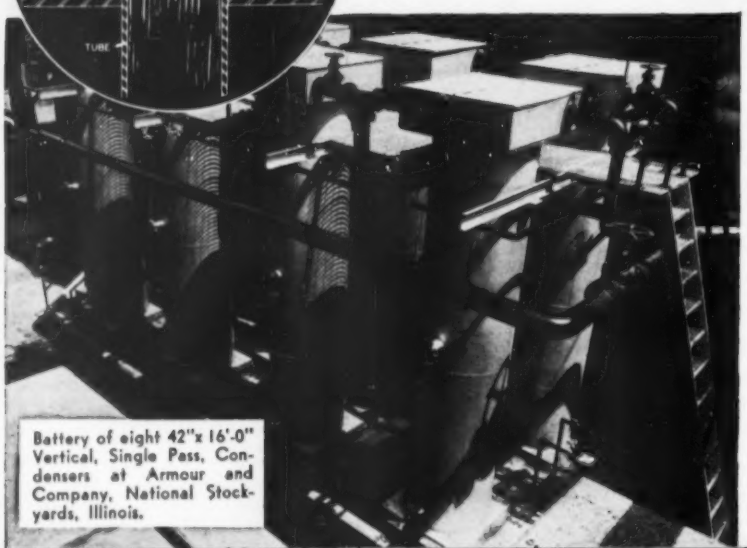


375 tons capacity Multipass Condenser installation at Railways Ice Co., Belen, New Mexico.



Vertical Single Pass Condensers
(Film Type)

Patented ferrules give equal distribution of water to and over the surfaces of all tubes in a unit.



Battery of eight 42"x 16'-0" Vertical, Single Pass, Condensers at Armour and Company, National Stockyards, Illinois.

HORIZONTAL and VERTICAL TYPES SHELL and TUBE CONDENSERS For Every Service

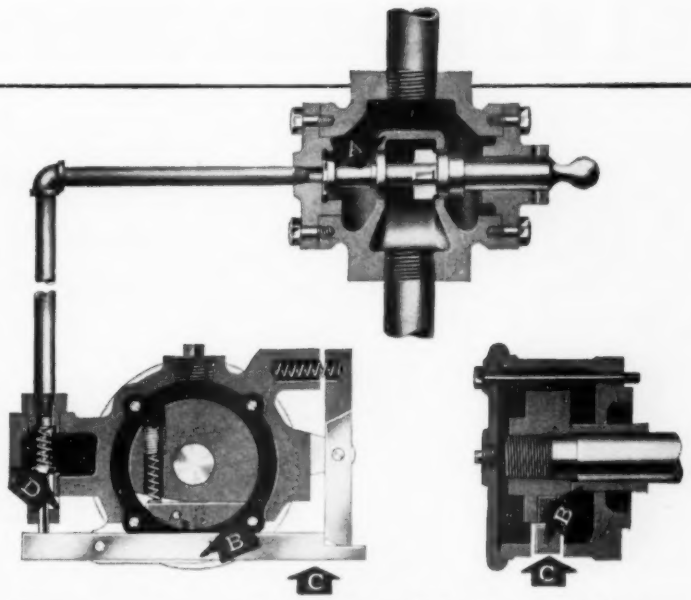
Write For Bulletin RC-1

HENRY VOGT MACHINE COMPANY
INCORPORATED
1000 W. ORMSBY ST., LOUISVILLE 10, KY., U.S.A.
Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.

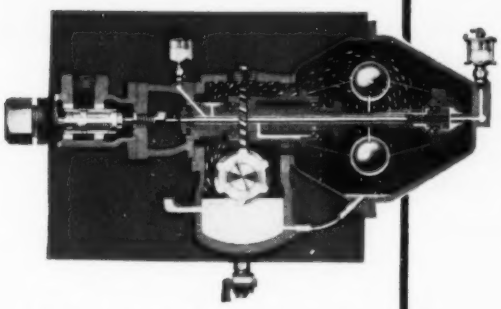
Vogt REFRIGERATION CONDENSERS

For more data circle 514 on Post Card

Only Coppus Turbines offer you *a pilot operated* excess speed safety trip



The constant speed governor on Coppus Turbines, plus this Excess Speed Safety Trip, gives you extra protection for your turbine investments. Here's how it works. When steam is turned on, pressure opens valve A fully. When excess speed is reached, centrifugal force throws weight B against lever C lifting pilot valve D. This releases pressure in back of valve A, closing this valve instantaneously, to shut off the steam. Safety trip can be tested easily while turbine is running by manually tripping and resetting lever C.



Sectional view showing lubricating system of fully enclosed Coppus Constant Speed Governor. Governor head acts directly on stem of steam admission valve. No external levers required. Ball bearing construction eliminates end play and gives frictionless operation.

Coppus Turbines ranging from 150 hp down to fractional in 6 frame sizes

CUT YOUR COSTS PER HORSEPOWER

When you choose from the Coppus Steam Turbine line, you get the right size for your requirements . . . and make substantial savings on *any* size from the 150 hp turbine down to the smallest. Low in first cost, Coppus Turbines save you more money in the long run. Operating and maintenance costs are kept low by such other features as: large number of steam nozzles, controlled individually by manually operated valves; hard chromium plating on shaft at the stuffing box; replaceable cartridge type bearing housings; optional carbon ring packing assembly for back pressures up to 75 pounds.

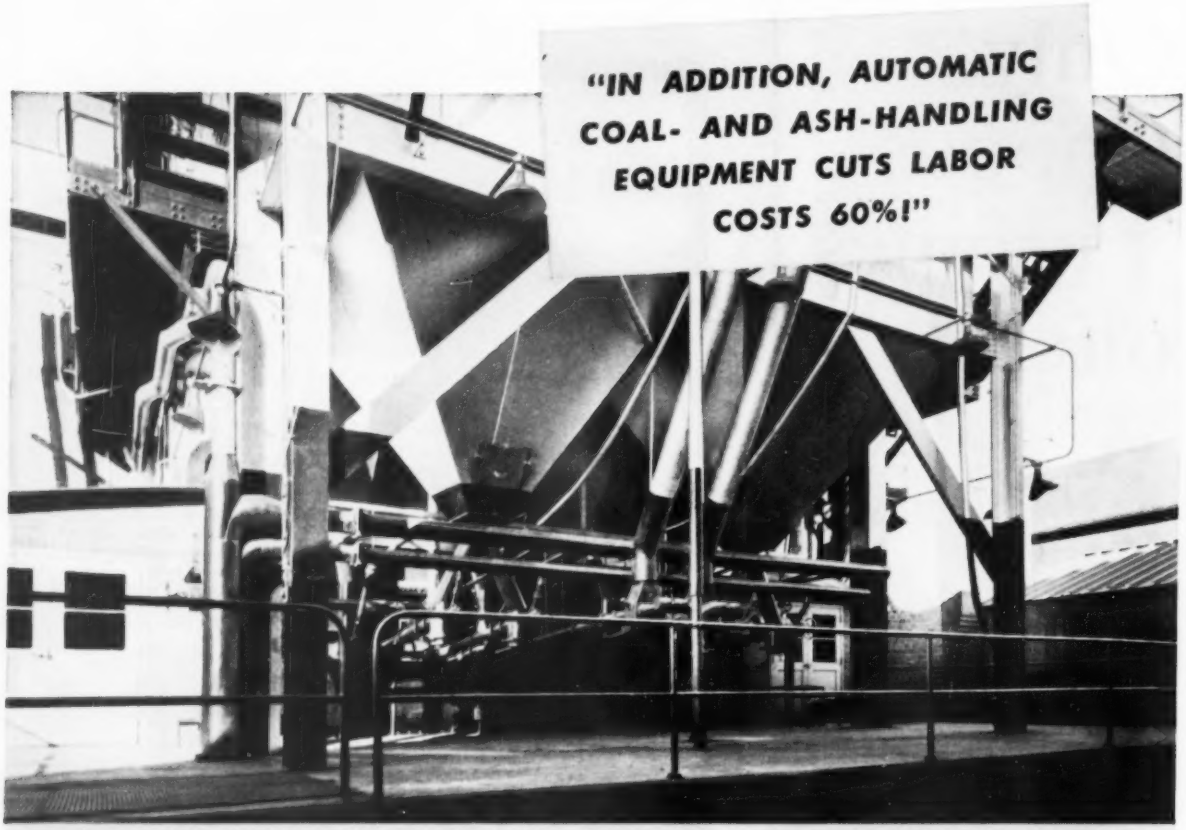
WRITE FOR BULLETIN 135

COPPUS ENGINEERING CORPORATION, 169 Park Ave., Worcester 2, Mass. Sales offices in THOMAS' REGISTER.

COPPUS "BLUE RIBBON" TURBINES

For more data circle 515 on Post Card

"WE MODERNIZED OUR PLANT, INSTALLED



This view shows how River Raisin has installed its modern fly-ash reinjection system at the rear of the boilers but outside the plant. The plant also features outdoor coal handling to save additional interior space. Coal is delivered to the stoker hoppers through automatic scales which weigh and record the flow.

If you operate a steam plant, you can't afford to ignore these facts!

COAL in most places is today's lowest-cost fuel.

COAL resources in America are adequate for all needs—*for hundreds of years to come.*

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

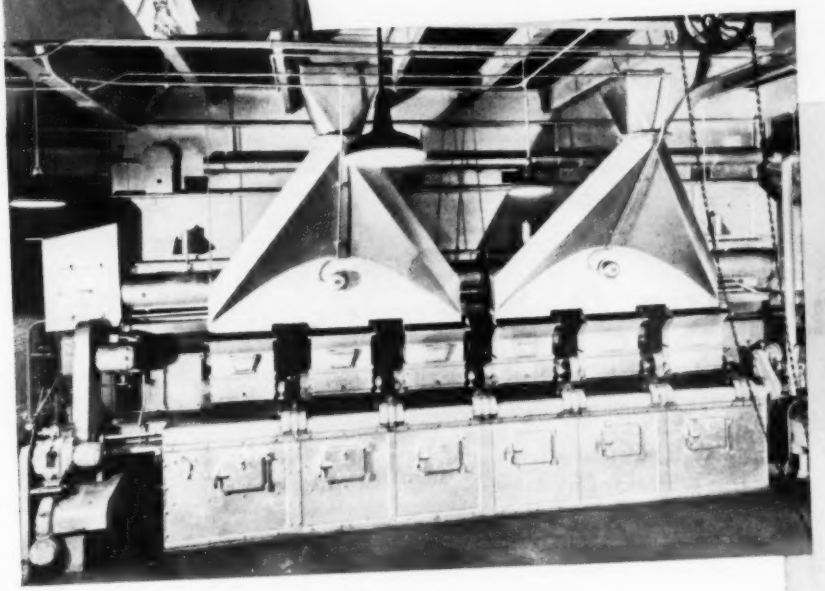
COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

FOR HIGH EFFICIENCY—FOR LOW COST

NEW COAL-BURNING EQUIPMENT, AND CUT OUR FUEL COSTS 45%!"

says Mr. A. J. Goetz, Executive Vice President, River Raisin Paper Co., Monroe, Michigan.

"We recently modernized our entire plant following an extensive engineering survey. New coal-burning equipment was installed...our coal-handling system was redesigned...heat losses were reduced...efficiency raised. As a result, our fuel costs have been cut 45 to 50%—proving to us that for economy and efficiency you just can't beat bituminous coal burned the modern way."



"These modern spreader stokers fully meet the special requirements of our operation. They feature low power requirements, low maintenance, and have the ability to meet fairly rapid load changes. They give us maximum efficiency under all operating conditions."

Modernizing your present plant? Building a new one? In either case it will pay you to get the *modern* facts about coal from a consulting engineer. He'll show you how an up-to-date coal installation can meet your *specific* needs—and at the same time save you more money than you thought possible.

With automatic coal- and ash-handling equipment you can cut labor costs to a minimum . . . and a modern combustion installation will give you more steam for less fuel. Actually, today, you can get from 10 to 40% more power from each ton of coal than was possible a few years ago.

And, if you burn coal, you'll never have to worry about a shortage of fuel. America's coal reserves are virtually inexhaustible, and this coal is mined by one of America's most efficient and productive industries.

This means that coal users—unlike those committed to other fuels—get the advantage of dependable future supply as well as the most stable prices.

BITUMINOUS COAL INSTITUTE
A DEPARTMENT OF NATIONAL COAL ASSOCIATION
WASHINGTON, D. C.

YOU CAN COUNT ON COAL!

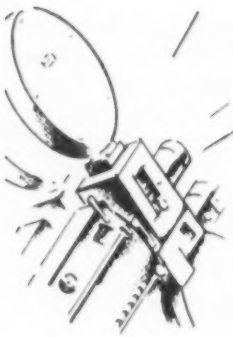
For more data circle 516 on Post Card

This is GARLOCK'S 3-Dimensional Picture

1. The Garlock representatives—112 of them—selling Garlock products and nothing else—making periodic calls on your plant—offering you the most complete line of mechanical packings manufactured by any company. These men are trained, experienced and, through interchange of information throughout the Garlock organization, conversant with your mechanical packing problems.

2. Twenty-three offices and three branch factories—with stocks of Garlock products—situated in most principal cities throughout the United States—convenient to you for prompt shipments and competent service.

3. Factories, laboratories, service engineers, resident engineers and pilot plant at Palmyra, New York—with background of sixty-six years' experience in the manufacture, application and development of superior quality mechanical packings—GARLOCK—The Standard Packing of the World.



This is the Garlock picture—unique in the mechanical packing industry. Take full advantage of it. It is yours for the asking.

THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK

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Branch Factories: Birmingham • Denver • San Francisco.

In Canada: The Garlock Packing Company of Canada Ltd., Toronto, Ont.

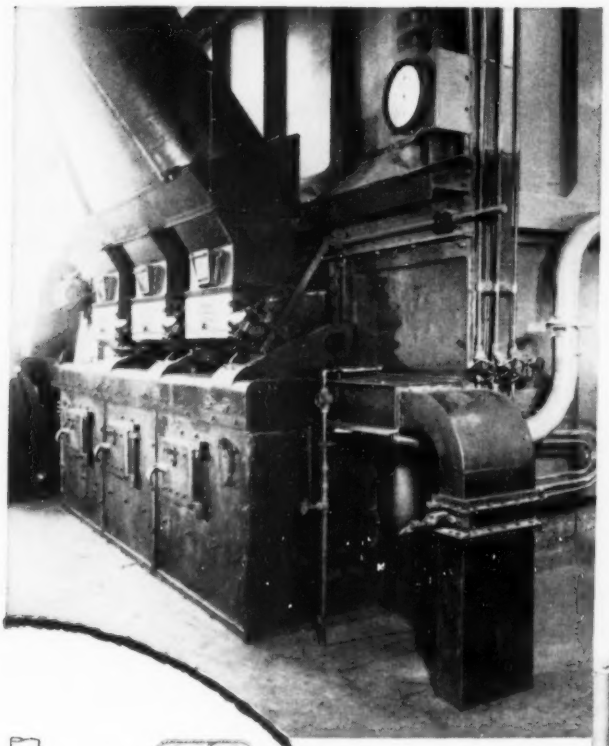
GARLOCK

PACKINGS, GASKETS, OIL SEALS,
MECHANICAL SEALS,
RUBBER EXPANSION JOINTS

For more data circle 517 on Post Card

24 hours a day 7 days a week

Detroit RotoGrate Stoker in Ladish Malting Co.



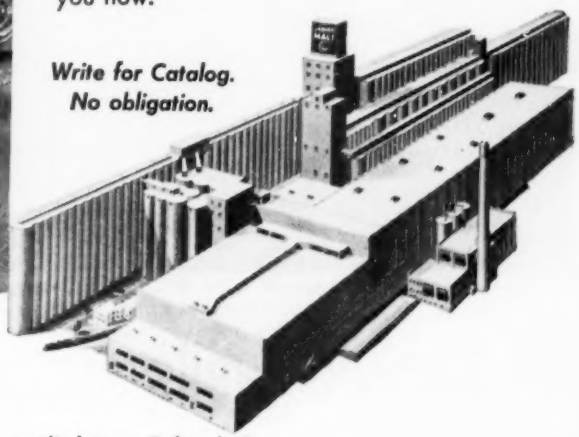
Exceptional reliability and very high availability are an utmost necessity in malting plant operation.

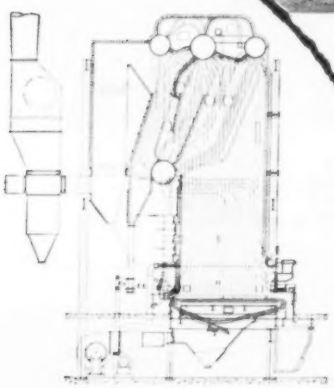
Enormous quantities of steam are needed in the Jefferson Junction, Wisconsin, plant of the Ladish Malting Co. for power and process. Ten million bushels of malt are manufactured annually. Steam generating equipment operates 24 hours a day and 7 days a week.

Difficult firing problems are always best solved by the use of Detroit RotoGrate Stokers.

Why not let them start saving money for you now.

Write for Catalog. No obligation.





Detroit RotoGrate Stoker applied to a Babcock & Wilcox—4 drum Stirling Boiler with Superheater and Economizer Capacity 75,000 pounds. 410 psi 600° F.

DETROIT STOKER COMPANY

GENERAL MOTORS BLDG., DETROIT 2, MICH.

WORKS IN MONROE, MICH.

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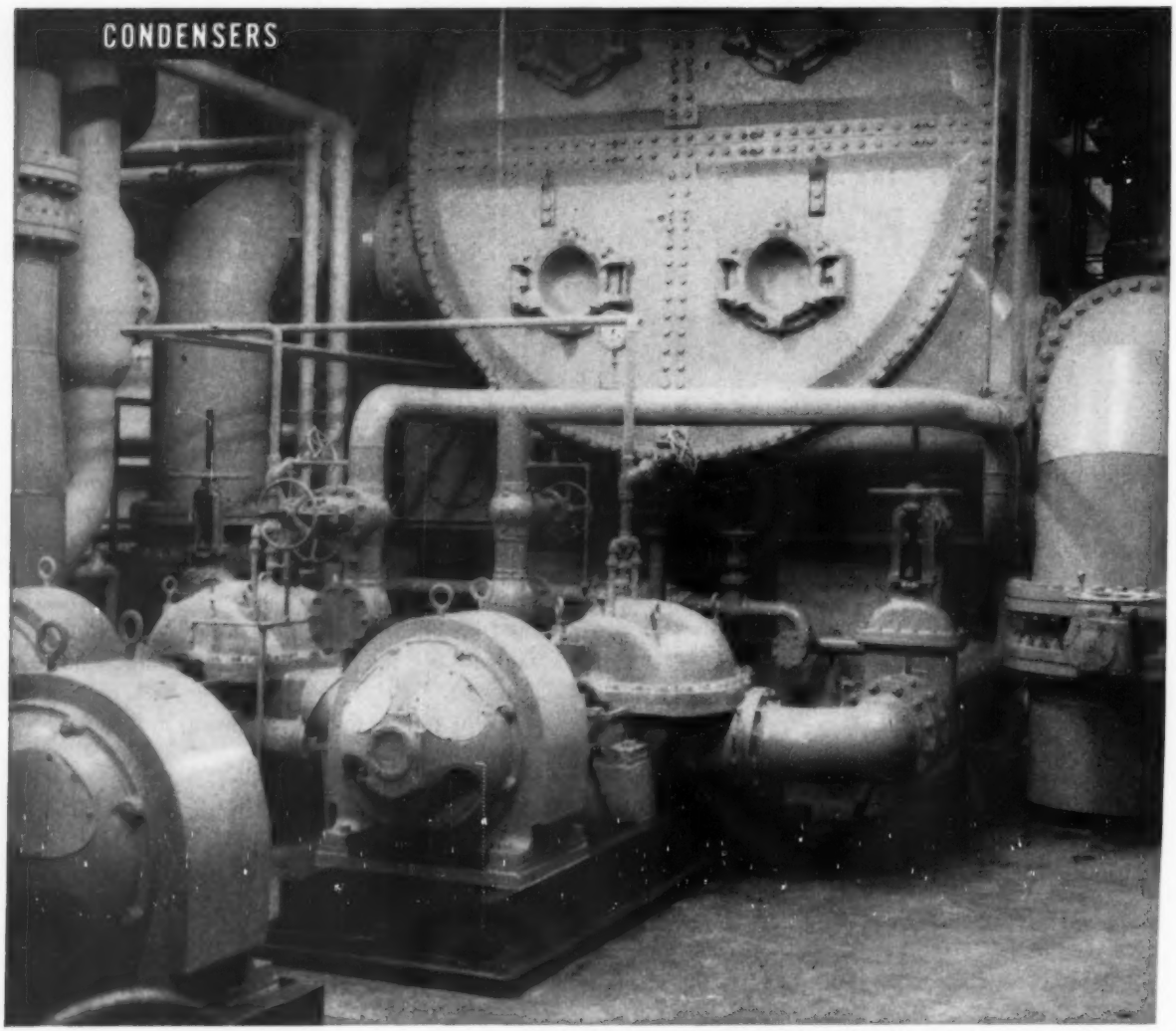
Worthington Steam

News and information about Worthington equipment for the steam power plant



WORTHINGTON'S 37,500 SQUARE FOOT CONDENSER at Columbus and Southern Ohio's E. M. Poston Station

Shallow wells supply all water for this Worthington-equipped power plant

The E. M. Poston Generating Station of the Columbus and Southern Ohio Electric Company, presently rated at 200,000 kw, gets its entire water supply from shallow wells 7000 feet away from the plant site. A 40-million gallon reservoir stores well water for emergency use.

Worthington equipment at the Poston Station now includes 3 condensers with all auxiliaries, including steam-jet ejectors, circulating water and condensate pumps—also deaerators, evaporator preheaters, and miscellaneous equipment.

Worthington, with over a century's experience in the manufacture of steam power equipment, is equipped to build efficient condensers in sizes to suit any practical limitations. Recently, the largest single-shell condenser in the world—125,000 sq. ft.—was made by Worthington for a large utility.

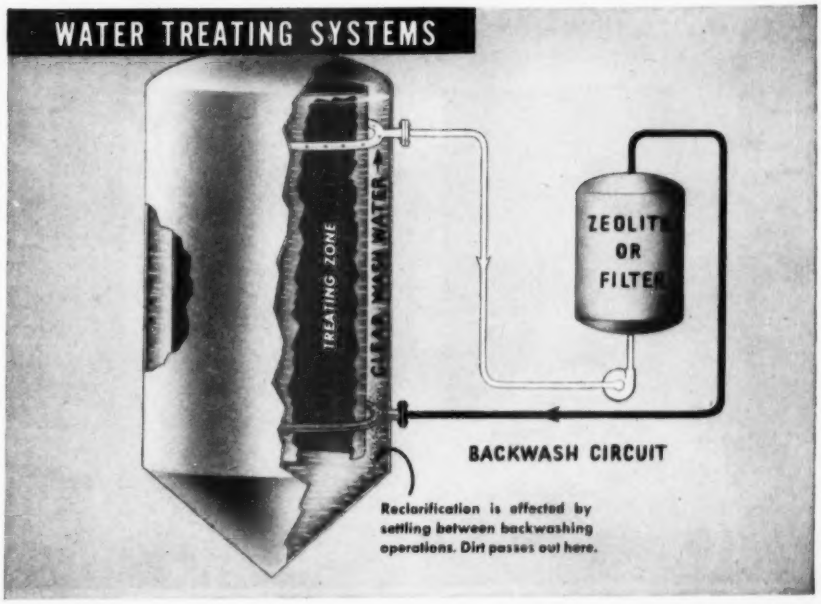
Power Bulletin

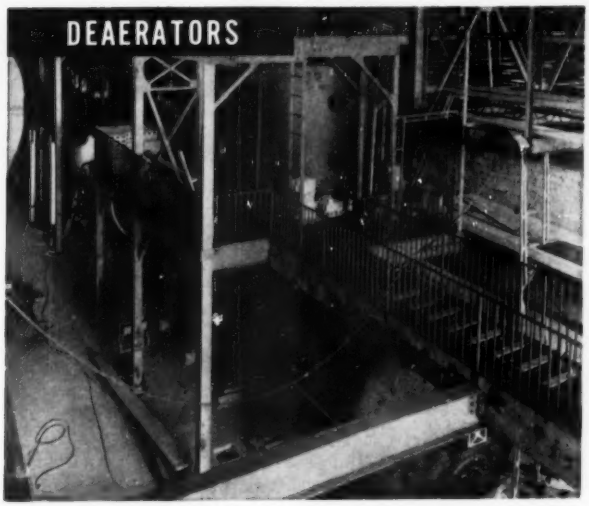
Condensers, deaerators, water-treating systems, and steam-jet ejectors and vacuum pumps as well as turbine generators, mechanical drive turbines and gears, circulating, condensate and boiler feed pumps, pressure filters, and air compressors.

Average Worthington Hot-Z systems pay for themselves in three years

Combining all the best features of hot process and zeolite systems, this Worthington Hot-Z slurry-type deaerating water softener operates on low-priced lime and salt. Studies show that average Hot-Z installations have saved enough in chemical costs to pay for themselves in three years!

Because Worthington makes more of the equipment for all types of water conditioning systems than any other manufacturer, you can be sure you'll get exactly what you need from Worthington. Write for Bulletin W-212 B-7.


WATER TREATING SYSTEMS
TREATING ZONE
ZEOLITE OR FILTER
BACKWASH CIRCUIT
Reclarification is effected by settling between backwashing operations. Dirt passes out here.



Dayton installs its newest Worthington deaerator

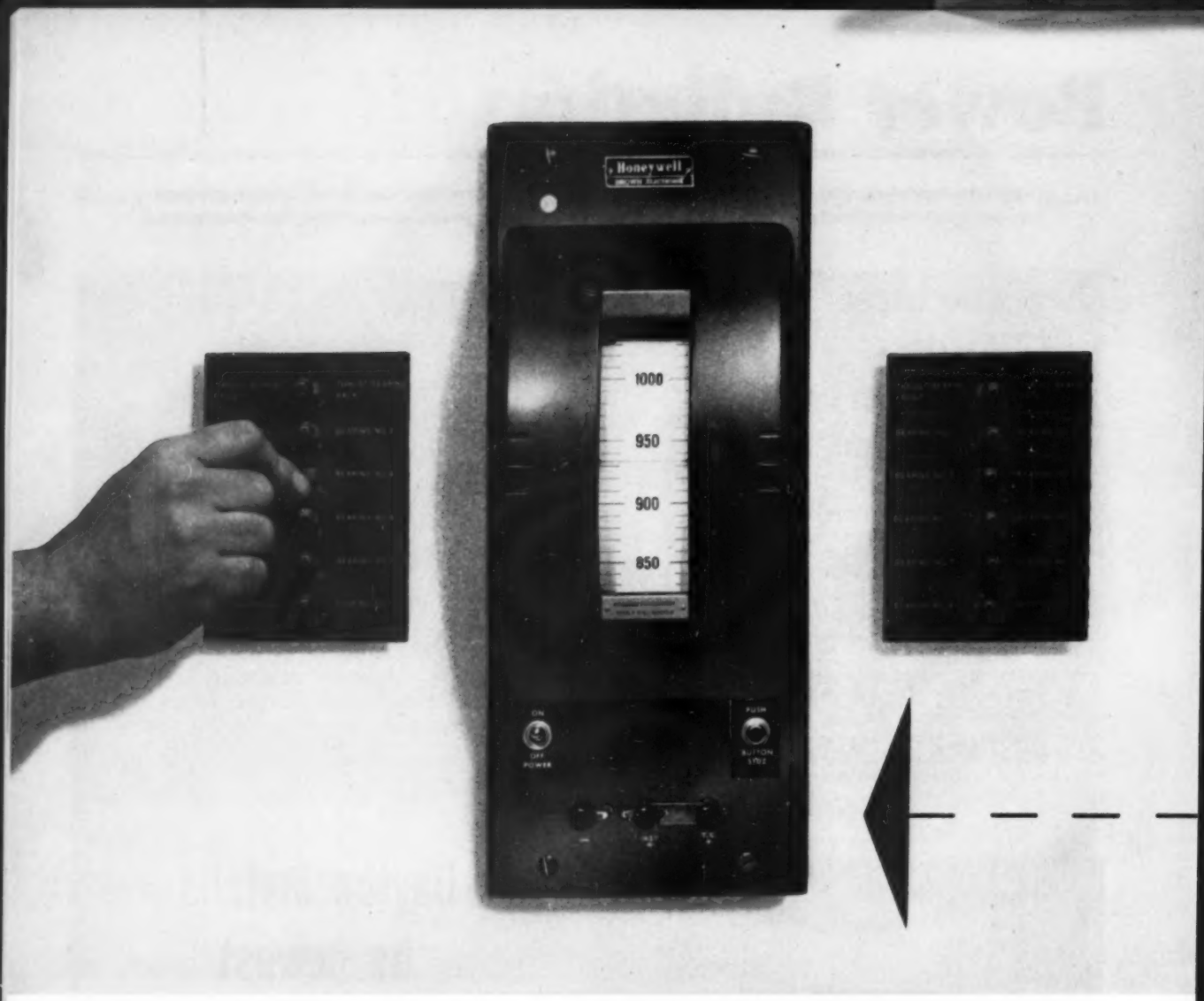
Worthington has supplied the deaerators for each new Dayton Power and Light Company installation since 1936. This new deaerator being installed at the O. H. Hutchings Station, in southwestern Ohio, is one of many Worthington units built in sizes to handle from a few thousand pounds per hour to over a million. Both tray and steam-jet types are made, with external surface-type vent condensers or internal direct-contact vent condensing. With a complete range of sizes and types at their fingertips, Worthington engineers can give you a deaerator exactly suited to your needs.

S.3.1.

Get in touch with your nearest Worthington district office for bulletins and information. Or write to Worthington Corporation, Steam Power Division, Section S.3.1, Harrison, N. J.

WORTHINGTON

For more data circle 520 on Post Card



Look at these features!

compact case
approximately 6½ inches wide by 15⅜ inches high

easily-read drum scale
rotates vertically; graduated length 28⅝ inches provides big, legible scale divisions and numerals.

accurate hairline index
eliminates parallax errors, permits high readability.

fast measurement
full scale rotation in 4½ or 12 seconds for 60-cycle operation.

external key switches
can be located at the side of the indicator (as shown), below or above—wherever most convenient for the particular panel layout.

large number of points
additional key switch banks provide any desired number of temperature points. Legend plates facilitate identification.

high precision
calibrated accuracy is 0.2% of scale span.

variety of ranges
supplied for use with either thermocouples or resistance thermometers, in a selection of ranges applicable to power plant temperatures.

Squeezed for panel space?

THIS NEW

Honeywell temperature indicator

needs no elbow room!

CROWDED PANELS are no problem for this new temperature instrument . . . the Vertical Scale Precision Indicator. Its slender, compact case makes it a natural for graphic panels—and a readily-inserted, space-saving member of conventional generator and turbine boards.

Basically, it's the same *ElectroniK* Precision Indicator which the power industry and many others have used and relied upon for many years. But, its outside appearance has changed: it's a completely new design that places the bulk of the instrument mechanism *behind* the panel . . . uses the valuable front-of-panel space primarily for the indicating scale.

Equipped with key switch banks, the Vertical Scale Precision Indicator offers a fast, convenient way to spot-check temperatures in bearings, pumps, hydraulic couplings, motors and other potential hot spots.

Your local Honeywell engineering representative will be glad to discuss how this new instrument can save space on the new panels which you may be planning. Call him today . . . he is as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4587 Wayne Ave., Philadelphia 44, Pa.

● **REFERENCE DATA: Write for new Bulletin No. 1541 on the Vertical Scale Precision Indicator.**

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls

For more data circle 521 on Post Card

Right on the nose

Specify SCOVILL PHOSPHORIZED ADMIRALTY HEAT EXCHANGER TUBES

The "hot tip" that produces a winner in heat exchanger tube applications need not be just a lucky guess. With Scovill men and methods behind you, you can be in the money practically every time.

The fact is that Scovill Heat Exchanger Tube Technical Service is considered by many to be the most competent and experienced in its field. Scovill Phosphorized Admiralty Heat Exchanger Tube is also definitely out of the ordinary because it is hot-extruded from our Continuous-Cast Billets. Continuous Casting assures uniformity in chemical composition and optimum inhibitor (phosphorus) content . . . means a dependably better tube, especially for service with contaminated or brackish circulating water.

Because Scovill makes a wide range of the most popular Heat Exchanger tube alloys, we can be completely impartial in making recommendations for your particular applications. Inquiry outlining your problems is invited. A 40-page technical booklet will be sent on request. For complete information, contact: Scovill Manufacturing Company, 99 Mill Street, Waterbury 20, Conn. Phone Waterbury 4-1171.

SCOVILL
HEAT EXCHANGER TUBE ALLOYS

- PHOSPHORIZED ADMIRALTY
- ADMIRALTY
- ARSENICAL ADMIRALTY
- MUNTZ METAL
- NAVAL BRASS
- RED BRASS, 85%
- DEOXIDIZED COPPER
- ARSENICAL COPPER
- COPPER NICKEL, 10% & 20%
- CUPRO-NICKEL, 30%
- CUPRO-NICKEL, 30% (High Iron)
- ALUMINUM BRASS
- ALUMINUM BRONZE, 5%
- DUPLEX TUBE

SCOVILL

"You can't buy better Brass"

39CS9

For more data circle 522 on Post Card

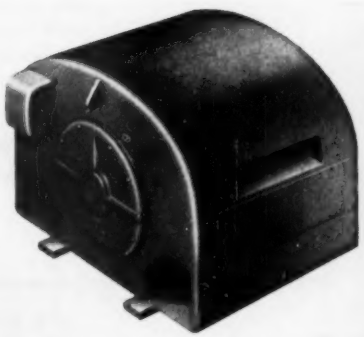
DALLAS POWER & LIGHT SAYS:

"G-E Weather-Protected Motors Give Us Dependable Service."

The Dallas Power & Light Company reports complete satisfaction with G.E.'s Weather-Protected Motors, used to drive induced draft fans. Developed by General Electric in 1949, they are the first successful outdoor ambient breathing motors—give outdoor protection at lowest possible cost.

General Electric's Weather-Protected Motors are available as Base Ventilated for high shaft applications and as Grade Mounted for low shaft applications. They have an effective low air velocity, air reversal system which practically eliminates moisture, dust, and other foreign materials from the cooling air.

For full data, contact your G-E Apparatus Sales Office or write for Bulletin 5810 to General Electric Co., Section 753-4, Schenectady 5, New York.



GRADE MOUNTED Weather-Protected Motors are designed so that driven rain, etc. blows *through* the air inlets—not into motor.

GENERAL ELECTRIC

For more data circle 523 on Post Card

Photomicrograph of one type of silica scale in early formation stage. Further deposits will fill in between the "trees" to form a dense, glass-hard, insulating covering that is extremely difficult to remove—and impervious to usual water treatment techniques.

STONE FOREST

(The boiler scale that fought back)

● When silica scale was mentioned, water-treatment experts used to change the subject quickly . . . until a plant using The Nalco System began having scaling troubles due to high silica content of the raw water.

That was many years ago. Today, the same plant, operating at 135 psi, maintains 500 ppm (29.4 grains per gallon) silica in boiler water without scaling.

The Nalco research program that solved this low-pressure boiler water silica problem is a continuous one, so that today The Nalco System successfully meets the challenge of silica wherever it arises in the field of water conditioning.

Whether your water treatment problem is silica—or something even tougher—Nalco has the solution, or can put the full facilities of the Nalco Laboratories to work on it for you.

LATEST STUDY ON SILICA CARRY-OVER

At operating pressures over 400 psi another silica problem—that of silica carry-over—often arises. One of the 1951 ASME papers, "Correlation of Silica Carry-over and Solubility Studies" is an up-to-the-minute, informative discussion of this problem. You are welcome to a copy. Just write to National Aluminate Corporation.

NATIONAL ALUMINATE CORPORATION

6222 W. 66th Place • Chicago 38, Illinois

Canadian inquiries should be addressed to Alchem Limited, Burlington, Ontario

THE *Nalco*® SYSTEM . . . Serving Industry through Practical Applied Science

For more data circle 524 on Post Card

Helpful Bulletins

THE ANSWERS to many of your operating and maintenance problems are found in these new and recently revised catalogs and bulletins. Circle item numbers of all catalogs wanted on the postage-free card below, detach and mail

INSTRUMENTS AND CONTROLS

101 Modern Measuring Instruments — Catalog GEC-1016A is a 64-pp revised edition containing information on more than 115 testing and measuring devices for laboratory and production line use. Fully illustrated, covers products ranging from simple current indicators to automatic oscillographs and radiation monitors. Describes each product briefly along with its field of application, and includes tables of important characteristics and prices, references to more detailed literature. General Electric Co.

102 Cable Fault Locators — Bulletin 65, 12 pp, discusses operation and applications of company's impulse cable fault locators and d-c proof testers, stressing high-voltage and current output with high energy input, moderate size and cost, other advantages. Illustrated with photos of equipment and circuit diagrams, bulletin also describes company's high voltage bridge and accessory pickup loop for use with the fault locators on buried cables. James G. Biddle Co.

103 For Metering Sulfur — Bulletin CEC-1810B describes the Trtrilog for the quantitative recording of sulfur compounds as low as 0.1 ppm. Explains how the instrument operates and discusses in detail its use in the natural gas industry and in air pollution control. Its use in connection with blending operations, corrosion of lines, appliances. Pictures both cabinet and portable models, tells rental and sales policies. Consolidated Engineering Corp.

104 Refrigeration Controls — Bulletin 109 describes the application of mercury-bulb instrumentation down to −30 F. Instruments presented cover conditions normal to food and drug processing, petro-chemistry, air conditioning, baking, etc., and include indicating, non-indicating and recording types. Explains operation, special features. The Partlow Corp.

105 Pump Recirculation Control — Eight-pp Bulletin S-53 describes control systems for protecting high capacity centrifugal boiler pumps during low load conditions. By recirculating water through the pump during these conditions, these systems serve to prevent overheating and binding at joints. Information on determining when such a system is needed is included. Both electrically and pneumatically operated systems are discussed. Republic Flow Meters Co.

PUMPS AND COMPRESSORS

106 Gear Pumps — Besides presenting all of company's standard gear pumps, 24-pp Bulletin 17-A describes briefly some special types engineered for unusual requirements. Discusses design, construction and operation of the pumps; tells how they're used in the power and industrial fields. Drawings, action photos, capacity and pressure tables and performance data supplement the text. Booklet covers pumps ranging from 1 gph to 1000 gpm capacities, types for handling viscosities from 30 to 10 million SSU. Schutte and Koerting Co.

107 Centrifugal Pumps — Bulletin W-300-B4 presents manufacturer's standard end suction centrifugal pumps which cover a wide range of applications and offer much interchangeability of parts. Includes charts showing the coverage provided by the six types of pumps in this line. Worthington Corp.

108 Industrial Air Compressors — Eight-pp Bulletin E-251 gives full data on company's 2-stage industrial air compressors from 10 to 100 hp sizes with displacements of 55 to 540 cfm. Comprehensive table shows number of industrial tools which can be operated by each size compressor. Davey Compressor Co.

ELECTRICAL

109 Power Transformer Cooling — Bulletin GEA-5969 describes and pictures the cooling system of forced-oil-air-cooled power transformers. Discusses unit coolers, directed flow, cooling efficiency, flow selector and control. Includes a large diagram showing directed oil flow in a power transformer. General Electric Co.

110 Circuit Breaker Operator — The Pneu-Draulic, a new hydraulic actuator for company's power circuit breakers which combines advantages of pneumatic and hydraulic principles, is introduced in Bulletin 71B7942. Includes a rating table for Pneu-Draulic equipped circuit breakers and typical speed graphs showing opening and reclosing and closing and opening of Pneu-Draulic operated circuit breakers. Allis-Chalmers Mfg. Co.

111 Generator Insulation Testing — Availability has been announced of an 8-pp report on high voltage d-c testing of generator insulation. The paper presents a comparison of a-c and d-c high voltage testing, with suggested procedures for testing insulation. The John Hewson Co.

112 Indoor Current Transformers — Bulletin GEC-956 describes dry-type indoor current transformers for operating watthour meters or instruments. Contains information on transformer's application, construction features, accuracy ranges, thermal rating, and various engineering aspects. General Electric Co.

113 Electrical Fittings — Sixteen-pp Catalog 53 describes company's line of solderless wire connectors and specialized fittings. Provides illustrated information on pressure connectors for solderless wire splicing and terminating, insulated bushings for electrical metallic conduit, snap-action plugs for plugging of knockout holes in wiring device boxes, and heavy duty molded terminal blocks. Includes specifications, dimensions and application tips. Buchanan Electrical Products Corp.

BOILERS, GENERATORS AND ACCESSORIES

114 Packaged Boilers — This 16-pp illustrated catalog describes manufacturer's new Type VP package boiler. Following a section of background information is an outline of the principal design features

SEPTEMBER, 1953
Card void in 6 months

POWER ENGINEERING

Please have the manufacturers send me without obligation information or bulletins indicated by the numbers circled below.

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of these boilers, which are shop assembled and provide steam capacities from 4000 to 30,000 lb per hour. Space requirements are shown in a table along with typical specifications. Also described is control system. Combustion Engineering, Inc.

115 Packaged Automatic Boilers — Bulletin 1219, 16 pp, describes company's Powermaster packaged automatic boilers in 17 sizes from 15 to 500 hp for steam process and steam and hot water heating service. Stresses outstanding constructional and operational advantages of the boilers; describes firing equipment, control systems. Typical installation photos included. Orr & Sembower, Inc.

116 Steam Generators — Data and specifications for completely plant assembled water-tube steam generators are contained in this 8-pp bulletin. There are nine sizes to pick from, ranging from 5,300 to 33,000 lb of steam per hours, for pressures up to 400 psi. These units are designed to provide fully automatic firing with oil, gas, or stoker-fired coal. Superior Combustion Industries, Inc.

117 Furnace, Boiler Cleaner — Applications and features of a furnace and boiler cleaner are shown in this brochure. Gives specifications of the cleaning unit, together with tools for specialized jobs, including chimney cleaning. Premier Co.

The Reader Service Card below needs no postage. Just circle item numbers of all bulletins wanted, fill in name, company, detach and mail

MECHANICAL POWER TRANSMISSION

118 Sprockets, Roller Chain — Bulletin A-624, 24 pp, is compiled to provide all data required for selecting and ordering roller chain and sprockets. A page is devoted to Taper-Lock sprockets for each size of chain from 40 to 100, giving sectional drawing, dimensions, number of teeth, maximum stock bore available, weights, prices and other data. Also provided is information on Taper Lock bushings for these sprockets, and on roller chains, both riveted and cotter types, and pin extractors. Data for roller chain drives includes service factors, ratings, speed ratios. Installation, adjustment, lubrication tips provided. Dodge Mfg. Corp.

119 A-c and D-c Brakemotors — Bulletin B-501-A, 8 pp, describes manufacturer's brakemotor and illustrates some variations in design adapted to specific industrial needs. The bulletin lists ratings, sizes, and voltage variations and contains a chart of relationships of torque, brake size, and applicable motor frame sizes. Also presented is a cut away showing how the brakemotor works. Star-Kimble Motor Div., Miehle Printing Press and Mfg Co.

LUBRICANTS, LUBRICATION

120 Lubricants, Fittings and Methods — Bulletin V-220, 12 pp, describes three major types of lubricants. A selection chart indicates specific lubricants for a large number of chemicals. A special feature of the bulletin is an illustrated outline of the three functions of a lubricant in the company's valves. The new combination button head fitting and lubricant screw is illustrated along with bucket pump, gun and gun accessories. Also includes servicing tips. Rockwell Mfg. Co.

121 Extreme Service Lubrication — Industrial grades and compositions of Molykote lubricants are described in this 8-pp Bulletin 100. Technical information on each grade is listed — for extreme pressure lubrication, extreme temperature lubrication, dry powder lubricant, grease consistency lubricant, and suspended dispersions of lubricant particles in various vehicles. Prices included. The Alpha Corp.

. . . Outstanding Among This Month's Catalogs

122 Ion Exchangers at Work — Twelve-pp Bulletin 2508 summarizes the properties of company's cation and anion exchangers and indicates some of their uses — many of them new. Details a general history of ion exchange engineering, gives data on selection of ion exchangers and lists general applications in the treatment of water and special problems associated with recovery of metals from solution, streptomycin purification, sugar refining, separation of rare earths, and waste treatment. The Permutit Co.

123 Burning Bituminous Coal — This 24-pp illustrated booklet is a compilation of numerous actual case histories of industrial plants and institutions which burn bituminous coal "the modern way." Stressing operating economy achieved, these case histories show problems overcome, equipment used, and savings realized. Bituminous Coal Institute.

124 Packings and Gaskets — Contained in this 40-pp belting and packing manual (NY-2697-P) are several helpful charts plus information on care, use and maintenance of rod and sheet packings and gaskets. There is a complete engineering section in the back of the book which contains all the necessary charts and tables for determining the working specifications of packings. Also included are two pages of packing recommendation charts covering general industrial services and refinery operations. New York Belting and Packing Co.

PIPING, VALVES, FITTINGS

125 Improved Pipe Hanger — Twelve-pp Bulletin 153 describes company's Counterpoise pipe hanger for high temperature piping systems in steam generating stations, refineries and chemical plants. Tells how it offers efficient load supporting effort of constant value throughout entire range of travel as pipe expands or contracts because of temperature changes. Graphs for aid in selecting proper hangers, tables of dimensions, plus erection and field adjustment instructions are given. National Valve & Mfg. Co.

126 Easily Operated Valve — Bulletin W-8 describes design and construction of company's Flowtrol suggested as a replacement for gate valves that require frequent manual opening and closing, or in place of diaphragm valves. Stresses air and water cushioning to prevent hammer or shock, easy installation, other features. Gives specifications, sizes of the valve, for use with water, air, and many liquids. Golden-Anderson Valve Specialty Co.

(*Continued on page 123*)

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Nothing succeeds like service!

● This turbine, one of the largest industrial units in the Midwest, was recently installed by a leading paper mill. The decision of mill officials to lubricate the new turbine with NONPAREIL Turbine Oil was based on their own experience with this outstanding product.

Beginning in 1941 in one unit, NONPAREIL has since been put into additional turbines; and, today, it lubricates all turbines in this big mill. Over the period of 12 years, it has not been necessary to replace any of the original fills of NONPAREIL because of lubricant deterioration or lubrication trouble. Oil systems have stayed clean. Oil acidity has stayed below 0.07 mg. KOH/gm.

In this mill, as in power plants throughout the Midwest, NONPAREIL has sold itself into one turbine after another. That success has been the result of superior turbine lubrication service. Service records of NONPAREIL cover up to 25 years' continuous operation of individual units on original fills of oil. Moreover, this unique lubricant carries a written guarantee that it will last as long as the turbine it lubricates and that its neutralization number will stay below 0.15 mg. KOH/gm.

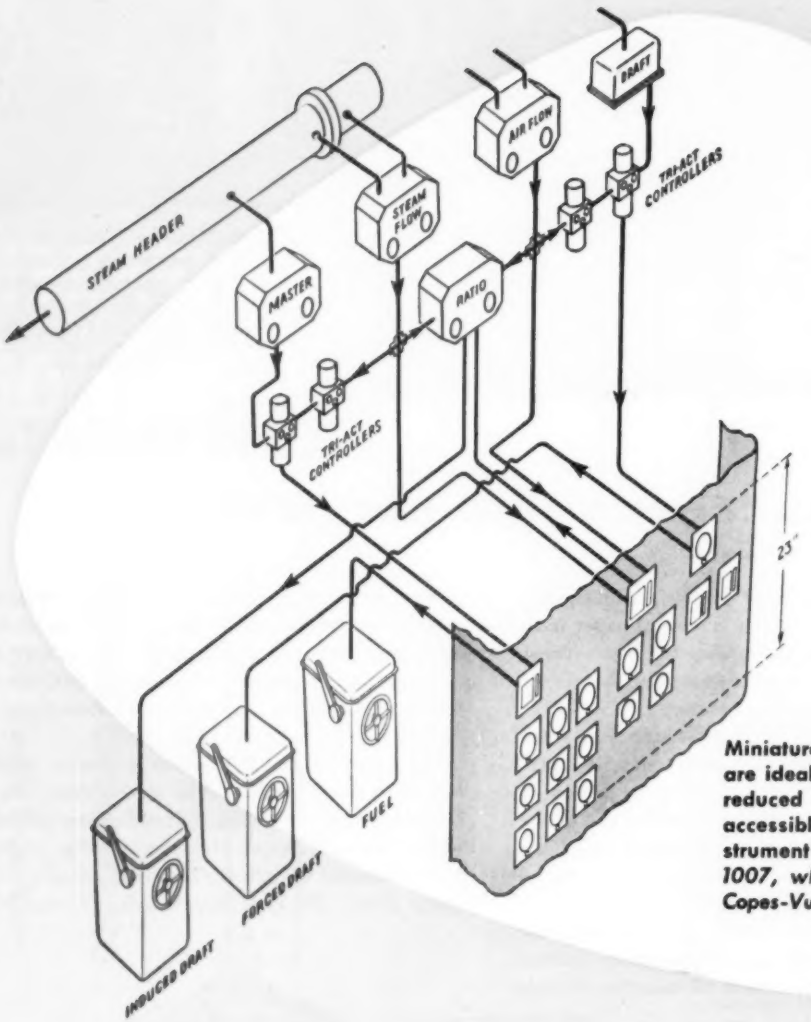
The Standard Oil lubrication specialist serving your section of the Midwest will be glad to show you lubrication records of NONPAREIL in installations similar to your own. You can contact this specialist by phoning your local Standard Oil office. Or, write: Standard Oil Company (Ind.), 910 S. Michigan Ave., Chicago 80, Illinois.

STANDARD OIL COMPANY STANDARD *(Indiana)*

For more data circle 525 on Post Card

C·V+T

COPES · VULCAN + *Taylor*



Miniature instruments as shown are ideal for graphic, console or reduced size panels. All parts accessible without removing instrument case. *Write for Bulletin 1007, which describes* complete Copes-Vulcan Boiler Control.

=BBC

= BETTER BOILER CONTROL

WHAT'S IN A NAME?

COPES has for half a century specialized in the control of boiler feed water flow and pressure, boiler water level—and, more recently, boiler steam temperature.

VULCAN has since 1903 brought soot blowing from an act of drudgery to the ease and convenience of merely pushing a button at a centrally located control panel.

Taylor has for over 100 years led in instruments for measuring and controlling temperature, pressure, flow and liquid level in the process and power fields.

Focus this broad new thinking on your boiler control problem. Combining the skills of three recognized leaders in power and process controls, it will mean Better Boiler Control, including:

Combustion Control from steam flow—air flow, or by fuel-air ratio. *Feed Water Control* from three, two or one influences—mechanical or instrument type. *Steam Temperature Control* from three or two influences, through burner or damper positioning, gas recirculating, direct cooling-water spray or heat exchanger. *Soot Blower Control* by fully-automatic sequence or from individual push button stations.

Standard or miniature instruments by Taylor permit any panel arrangement—conventional, console or graphic.

And Copes-Vulcan assumes undivided responsibility for service whenever or wherever needed—throughout the life of the installation.

COPES-VULCAN DIVISION
CONTINENTAL FOUNDRY & MACHINE COMPANY
ERIE 4, PENNSYLVANIA

COPES VULCAN **BOILER CONTROL**

WITH INSTRUMENTATION
BY *Taylor*

For more data circle 526 on Post Card

Safeguard

WORKERS PLANT PRODUCTION

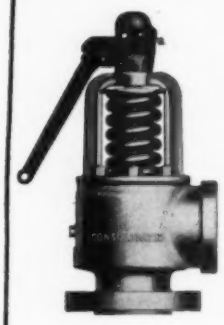
Specify

CONSOLIDATED SAFETY VALVES

The dependability and high performance standards of Consolidated Safety Valves assure maximum protection of employees, plant facilities and production. Proved in thousands of installations during the past 75 years, these spring-loaded valves provide high discharge capacity, positive and tight closing after operation.

The capacities of all Consolidated Safety Valves are guaranteed and proved by flow measurements. A 2100-pound design boiler, used exclusively for testing and setting, is further assurance that Consolidated Safety Valves are the best protection available.

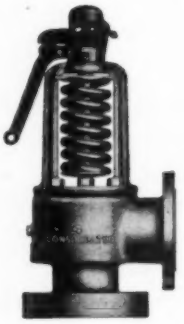
Whatever your working pressures and temperatures, the complete line of Consolidated Safety Valves makes selection easy for your particular needs. They have few working parts, are tough, and require little maintenance throughout their long service life. Full information, including safety and service feature data, are yours on request. Write for Catalog 700.



TYPE 1411 IRON BODY SAFETY VALVE

Sizes: 1½" through 6"
Pressures: Up to 250 P.S.I.
Temperatures: Up to 450° F.
Standard Connections: Threaded or flanged.

Designed with a bevel seat, single ring blowdown control and a one-piece feather (disc), this high capacity, wing guided valve incorporates every feature essential to complete dependability, positive protection and ease of maintenance. Recommended installations include water tube boilers, mechanically fired fire tube boilers, accumulators, unfired pressure vessels and pipe lines within its rated capacity. All sizes available with oversize inlet flanges for replacement purposes.



TYPE 1415 STEEL BODY SAFETY VALVE

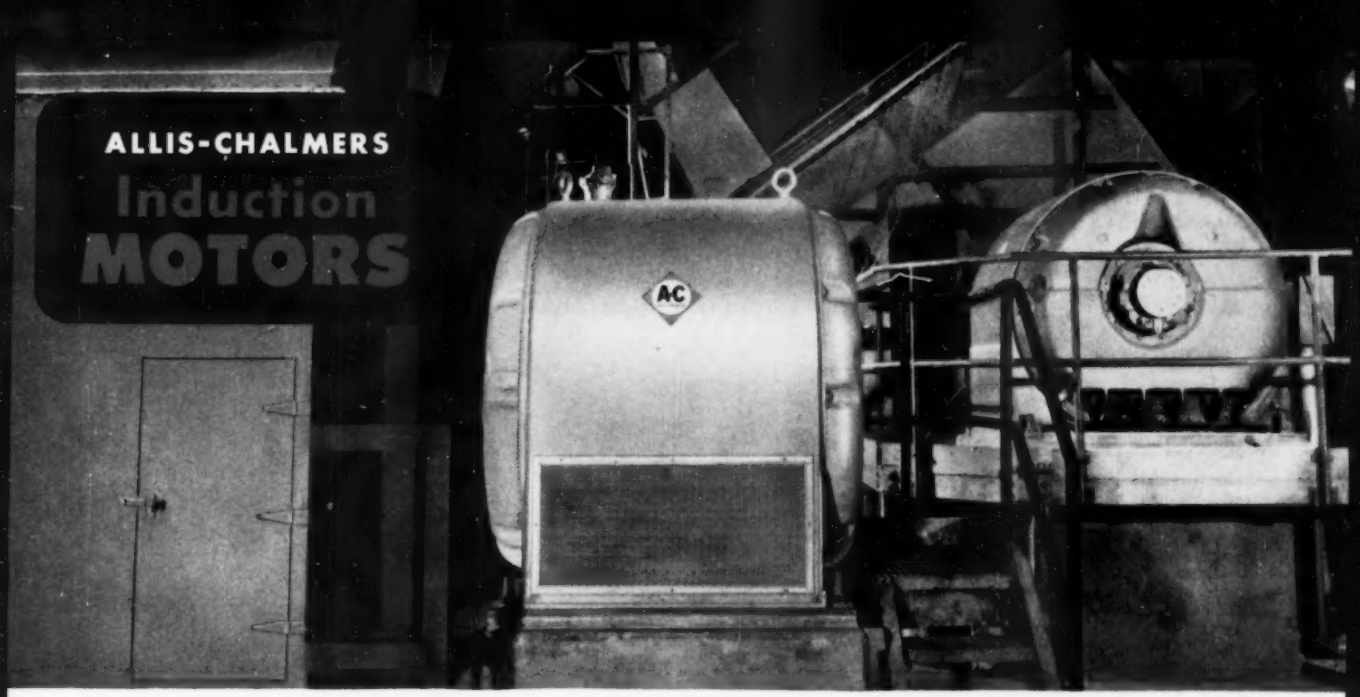
Sizes: ½" through 6".
Pressures: Up to 600 P.S.I.
Temperatures: Up to 900° F.
Standard Connections: Flanged.

Body is cast steel. Has a high erosion and corrosion resistant stainless steel seat bushing **seal welded to the base.** Recommended for all applications beyond the scope of its companion valve in cast iron, Type 1411 shown above. It is a high capacity wing guided valve with fully exposed spring—a rugged, dependable and economical valve proved in thousands of field installations. Available with oversize inlet flanges.

CONSOLIDATED SAFETY VALVES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONN.
MAKERS OF 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'HANCOCK' VALVES, 'ASHCROFT' GAUGES. BUILDERS OF "SHAW-BOX" CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

For more data circle 527 on Post Card



Left to right (above) are drip-proof, silicone insulated, 1000-hp, forced and induced-draft fan motors for unit No. 2. Forced draft fan motors for unit No. 3 will be of the weather-protected type for installation outdoors.

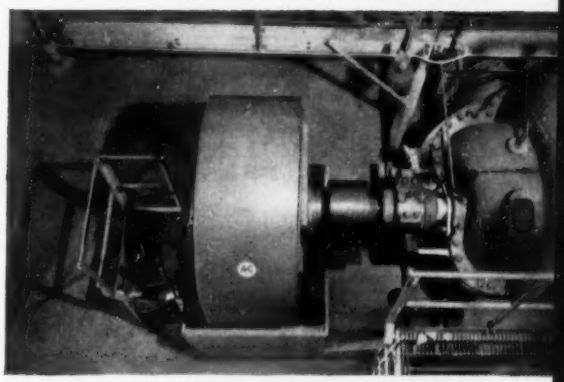
LET'S TAKE A LOOK AT TANNERS CREEK

One thing you're sure to notice at the Tanners Creek plant is that all the major auxiliaries for generating unit No. 2 are driven by Allis-Chalmers motors. Pictured here are a few of the larger ratings in this modern power plant of Indiana & Michigan Electric Company, a part of the American Gas and Electric system.

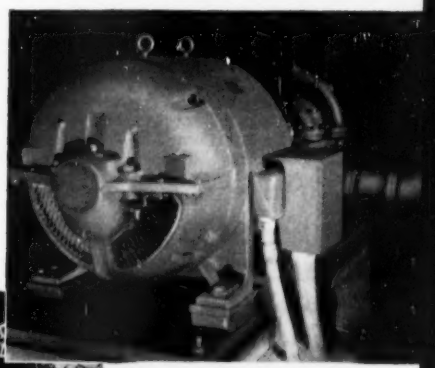
It's worthy of note that A-C is also building the motors for generating unit No. 3, scheduled for operation in 1954.

Allis-Chalmers builds a complete line of integral horsepower motors for power plant service, and your A-C representative can help you select the motors you need.

A-4084



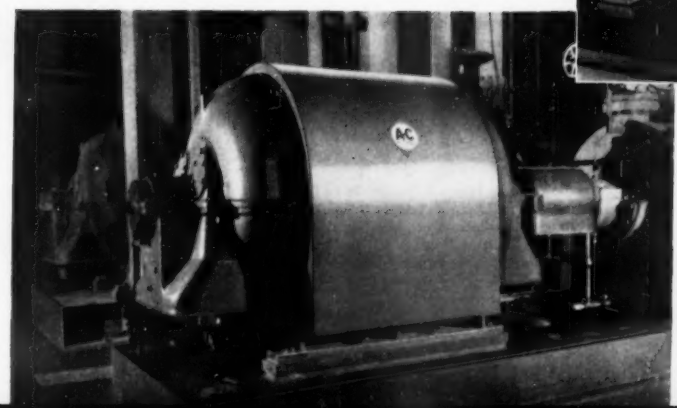
One of two 300-hp, 2300-volt, 218-rpm, drip-proof squirrel-cage motors driving circulating water pumps.



Rated 200 hp, 2300 volts, 1760 rpm, this drip-proof squirrel-cage motor driving an Allis-Chalmers screen wash pump is typical of the smaller ratings.

ALLIS-CHALMERS

Milwaukee 1, Wisconsin



These dependable boiler-feed pump motors are rated 2000 hp, 2300 volts, 3580 rpm each.

Equipment News

SUMMARIZED HERE are new products and improved ones . . . recent developments of leading manufacturers who will gladly supply further information at no cost. You may use the no-obligation, postage-free cards on pages 37 and 123 for your request. Just circle the numbers of the items you'd like to know more about

1—GEARMOTORS

Feature oil seal between the gears and high-speed bearing

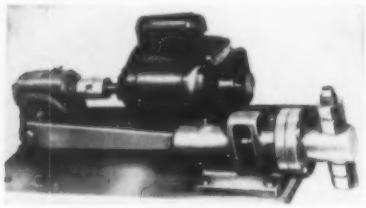
A new line of gearmotors features a selection of compact, integral power units with single (780 to 280 rpm), double (230 to 45 rpm) or triple (37 to 7.5 rpm) speed reduction. These units are available with any of the manufacturer's motors: a-c, squirrel-cage, wound rotor, d-c or multi-speed, in open-protected, splash-proof, totally-enclosed non-ventilated, totally-enclosed fan-cooled and explosion-proof closures. Frame sizes range from 1 to 150 hp. Mountings may be horizontal, ceiling, sidewall or inclined. A complete integral power unit is available with the company's disc brake.

A positive oil seal between gears and high-speed bearing is provided to lengthen bearing life by sealing off abrasive matter. A large oil reservoir provides efficient splash lubrication for gears. Elliott Co.

2—PROPORTIONING PUMPS

Are low-cost units for boiler water treatment, general industrial use

Standard models of these pumps meter viscous materials, slurries, suspended solids and corrosive liquids from 0 to 100



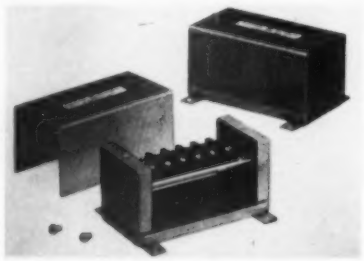
gph at pressures to 1200 psi; special units have capacities to 300 gph at pressures to 20,000 psi. Automatic controlling devices are available which adjust capacity while pump is operating, and all models can be made with special metals, oversized valves, water seals and motors to meet particular conditions. In addition, the pumps are designed so that packing can be changed without breaking pipe connections. Walter H. Eagan Co., Inc.

3—METAL ENCLOSURE

For terminal blocks, keeps out dust, protects personnel

This sturdy metal enclosure is designed to alleviate the problem of excess dust and to protect personnel where terminal blocks carrying high voltages must be mounted near avenues of traffic. The enclosure comes with manufacturer's M or MT Terminal Blocks, integrally mounted with from up to 14 terminals per block and enclosure. Cover is held in place by two screws and, when removed, leaves three sides of enclosure open for easy connecting of wires or circuit changes.

Two standard $\frac{7}{8}$ in. dia knock-outs



are provided, one at each end of the enclosure, to permit cable or wires to be fed in under the terminal block for simple distribution and connection to either side of block. Circuits can be coded for quick identification of wires. The terminal blocks, which are furnished as standard in this new enclosure, are rated at 300 v, 15 amp. Manufacturer says these enclosures will be available at present only in minimum quantities of 100 units. Curtis Development & Mfg. Co.

4—FHP V-PULLEYS

Feature improved hub design, easy assembly and removal

Basic improvements in this company's line of QD (quick detachable) Junior FHP V-Pulleys are centered about a flanged type split taper bushing permitting the hub to grip the shaft and still allow easy assembly and removal. The pulley is a simple two-piece assembly, drawn together by three slotted hexhead machine screws. Two additional tapped holes allow removal of the pulley from the hub by using the assembly screws as jack screws to break the cone grip. Assembly or removal may be performed with a screwdriver or wrench.

One common hub is utilized for the complete range of pulleys from 3.5 in. PD to 15.4 in. PD with a bore range of $\frac{1}{2}$ in. through $1\frac{1}{4}$ in. by $\frac{1}{16}$ in. increments. The larger sizes have I-beam arms to give more strength with less weight. A descriptive bulletin is available. Worthington Corp.

5—FLEXIBLE HOSE

For fume exhaust and ventilating; is easily handled, stored

Portovent is described as an inexpensive, easily handled, flexible hose with unusual lengthwise compressibility It has excellent air flow characteristics and maintains large cross section even on sharp bends, manufacturer says, and it is easy to install, transport and handle.

This hose is made from cotton or nylon fabrics, impregnated with Neoprene compound and reinforced with spiral wire, and it can be supplied in sizes from 4 to 36 in. ID in any desired length. Because it is bonded and not stitched, this hose can be cut to size in the plant without raveling, it is pointed out. American Ventilating Hose Co.

6—SMALL LIGHTNING ARRESTER

Compact and light-weight unit; can be applied anywhere on system

The Magne-valve lightning arrester is being used on company's 7200- and 7620-v pole-type distribution transformers. For 7200-v transformers, the 9-kv arrester is $14\frac{1}{4}$ in. long and weighs 10 lb. The 10-kv arrester for 7620-v transformers is $15\frac{1}{2}$ in. long and weighs 11 lb.

Gapped to the bushing in the same manner as modern pellet arresters on 2400- and 4800-v unit-type transformers, the new arrester features valve action augmented by magnetic action of internal series gaps, to permit application anywhere on the system without regard to 60-cycle short-circuit currents.

The arrester also features an external gap; there is no 60-cycle voltage applied to the arrester under normal conditions and virtually no chance for grounding circuit even if arrester is damaged, it is noted. General Electric Co.

7—LATEX-BASE PAINT

Goes on fast and dries fast; provides a flat finish

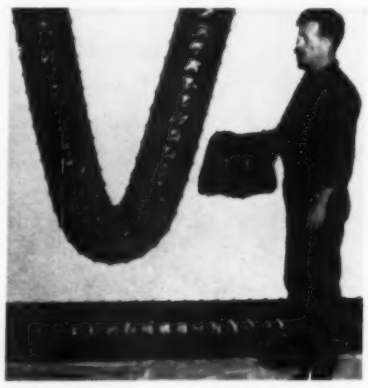
Professional Ultra Flat Latex Paint is formulated to meet the needs of maintenance engineers and painters; and to combine economy, speed and single-coat application with covering and sealing qualities. It may be sprayed, brushed or rolled on, and is reported to dry in about half an hour.

No objectionable odor is given off, manufacturer says — a room can be occupied 15 min after painting, and interiors may be redecorated without shutting down because of toxic or foul odors. Non-combustible, the latex base finish is said to act as a fire retardent after it is on the walls. Its "dead flat" surface serves to eliminate glare and boosts light reflection and diffusion. The new paint is available in white and 10 colors. Glidden Co.

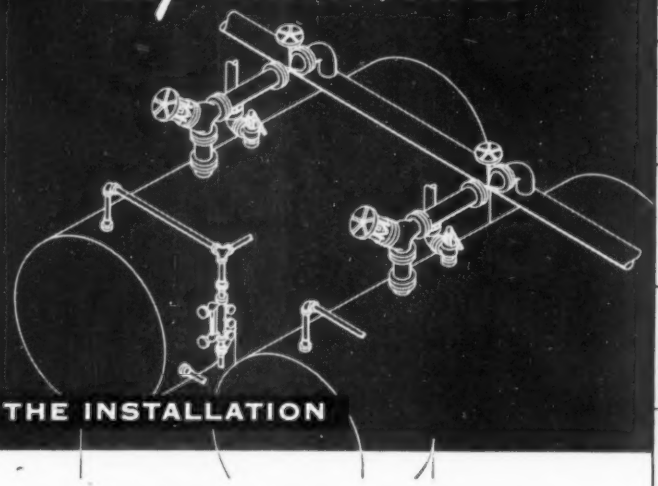
8—COMBINATION CHAIN

For bucket elevators and conveyors, is designed for long service

According to manufacturer of this chain, there is 450 to 600 per cent more metal on the wearing tread of each link, a feature which extends the service life of the chain. The chain has block links cast of malleable iron or Beauco-CR metal, depending on the application. Side bars are of high carbon steel. Connecting pins of forged steel are used on the malleable iron chain, and heat-treated steel pins are supplied with the Beauco-CR chain. Beaumont Birch Co.



30 Years of Safety and Efficiency with these High Quality Stop-Check Valves



THE INSTALLATION

At the Eureka Redwood Lumber Company, Eureka, Calif., featuring eight 5-in. Crane stop-check valves on boiler lines to main steam header.

VALVE SERVICE RATINGS

SUITABILITY:	On the job for 30 years
FEATURES:	Only one moving part
MAINTENANCE COST:	One seat regrinding only
SERVICE LIFE:	Installed 1923 – still O.K.
OPERATING RESULTS:	Efficient performance – safe operation
AVAILABILITY:	Crane Catalog item – No. 30E

THE CASE HISTORY

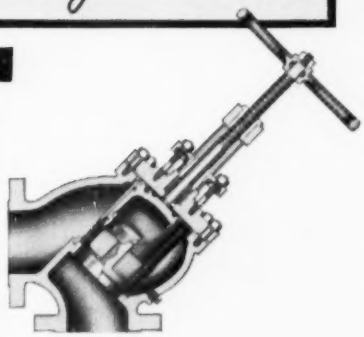
Thirty years' continuous service is by no means the record for Crane 250-Pound stop-check valves. But when 6 such valves, all installed in 1923, are still on the job, and still giving complete satisfaction, surely that's worthy of note. So well did these Crane No. 30E stop-checks perform right from the start, that 11 years later, in 1934, 2 more were put on boilers installed that year.

Here are 8 valves with a collective service record of more than 220 years. And in all that time, the only maintenance required was regrinding the seat of one valve.

It takes a lot of quality to deliver such valve performance with so little upkeep. That's why today, in face of rising maintenance cost, Crane quality is more than ever the first choice of the thrifty valve buyer.

THE VALVE

Simplicity and dependability are still the chief characteristics of Crane 250-Pound stop-check valves. They have just one moving part—the piston-type disc that operates in a removable liner, without chatter, vibration, or rapid wear. You'll have a safer power plant with these valves on your boilers, and they'll permit steam flow to the main header at minimum pressure drop. See your Crane Catalog or Crane Representative for complete information.



THE BETTER QUALITY...BIGGER VALUE LINE...IN BRASS, STEEL, IRON

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

For more data circle 529 on Post Card

9—WEATHERPROOF FANS

For severe outdoor applications and where fan is unattended

Suggested for transformer cooling and similar applications, these new fans are available with blade sizes of 16 to 30 in., with air delivery ratings from 2820 to 6710 cfm. All sizes have company's airfoil cross-section aluminum propeller, and may be obtained with or without cradle type mounting stand.

The fans are well protected against the elements. The welded steel mounting ring assembly is phosphatized before painting for corrosion resistance and paint adherence. The weatherized motor has rubber gaskets that seal the removable cast iron end heads, and the sealed pre-lubricated ball bearings are protected by a grease-filled cavity in the hub that provides a moisture seal around the shaft. A neoprene flinger on the shaft keeps moisture out of the motor on vertical installations.

Single phase 110/220 v motors have an automatic reset type thermal overload protector; three-phase motors for 220/440 v service are available, but without thermal protective device. Propellair Div., Robbins & Myers, Inc.

10—STEAM VALVE

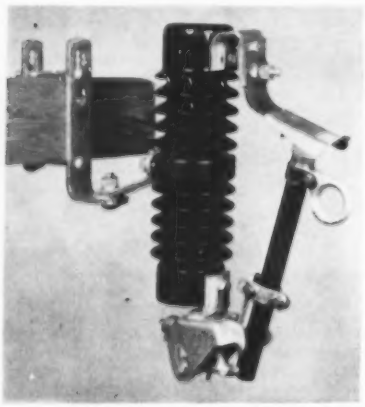
Is designed to prevent "sticking" and reduce maintenance costs

Expansion caused by high temperatures combined with iron oxide, boiler compound, and lime is a frequent cause of "sticking" and down-time, it is pointed out. This valve is designed to automatically compensate for normal expansion and deposits. Atkomatic Valve Co.

11—LOAD BREAK DEVICE

For better fault protection or opening of circuits under load

A new line of open-dropout fuse and load-break cutouts features a hollow-tube, wet-process, porcelain insulator with the mounting support clamped to the porcelain by a U-bolt insulated with polyvinyl chloride insulation, for bird-proof construction, and a shielded top contact and latch for better protection from dirt or sleet. Top and bottom fittings are compression-bolted to porcelain for maximum mechanical strength. The new line includes ratings of 7.8 kv and 15 kv, 100 amp. Three interchangeable fuseholders provide NEMA standard 2000-amp interrupting rating, heavy-duty 5000-amp interrupting ratings, and a load-break up to 100 amp.



Company engineers say that the load-break device, which consists of a simple lever arm attached to a fuseholder, provides a low-cost means of sectionalizing main feeders, switching transformers, and other loads. General Electric Co.

12—IMPROVED WRENCH

Is versatile tool with clamping action adjustable to 2000 lb pressure

Only four parts comprise the Clamp Wrench: body, sliding jaw with parallel movement, locking lever, and adjustment knob. To use it, you place the wrench on part with jaws set, then turn

the adjusting knob until desired clamping pressure is obtained. The tool clamps at right angles for more torque. This hand tool can be used for welding or soldering clamps, holding small parts for grinding, twisting sheet metal, and can substitute for monkey wrench or pipe wrench. It sells for less than $4.00. Clamp Wrench Co.

13—SINGLE-PHASE MOTOR

Capacitor-start, capacitor-run; offered in 5-, 7½-, and 10-hp ratings

According to manufacturer of the new Type CAP-2, the elimination of wound rotor, brushes, and commutator of the previous repulsion-induction design has produced a motor which requires less maintenance and eliminates sparking, a cause of radio interference and possible fire hazard. Where three-phase power is not available, this new design is intended to permit use of larger single-phase motors for air conditioning units, oil-well pumping, and similar operations.

Capacitor-run motors operate efficiently at near-unity power factor, it is pointed out, and their design reduces starting current 25 per cent, with high starting torque. Auxiliary winding remains in circuit during operation in series with running capacitors. Relays remove starting capacitors when motor approaches full speed. Main winding is directly across the line. This is a four-pole, 220-v, 60 cycle motor. Westinghouse Electric Corp.

14—OXYGEN METER

Makes direct physical measurement on oxygen content of sample gas

Designed to measure oxygen content directly without using filaments, catalysts, chemicals, or secondary methods of measurement, the Model F-3 Oxygen Analyzer works automatically, company says, requiring no operator except for occasional standardization checks. Accuracy is given as ±1 per cent of full scale. It will operate almost any standard potentiometer-type recorder, making it useful for general industrial applications where accurate oxygen measurement and control are necessary to plant operating efficiency, as in power plants, refineries, chemical processing plants.

Because of its high paramagnetic properties, oxygen can be measured more accurately and conveniently by this method than any yet developed, it is stated, and measurements can be made on virtually all types of gasses, hot or cold, without altering normal composition. Bulletin 108 describes the instrument. Arnold O. Beckman, Inc.

15—HEAVY-DUTY AIR HOSE

Has steel wire braid reinforcement and oil resistant gray cover

The Commander Air Hose is reinforced with a single braid of high tensile steel wire. It is said to be more flexible than many types of heavy duty air hose and to be suitable for working pressures as high as 400 psi.

This air hose is designed for use where high working pressures are required or where the hose cover is subject to severe abrasion. An oil resistant hose tube permits tools to be oiled through the hose. It is manufactured in ½-, ¾- and 1-in. sizes. The B. F. Goodrich Co.

16—PARALLEL SPACER

For drawing parallel lines uniformly, 0.025 to 0.375 in. distance

Fourteen gradations are designated on the No. 10 Parallel Spacer. To use it, you insert your pencil point in the selected hole and guide the tracer along the edge of the straight or curved figure.

This plastic spacer can be used for graph plotting, mapping, or cross hatching. It is 2 in. in diameter, costs about 50 cents. RapiDesign, Inc.

17—CHEMICAL FEED UNIT

Has 50- or 100-gal tank mounted over pump; is ready for installation

This self-contained assembly is completely piped and ready for connections to plant chemical feed piping and to electrical control equipment, manual or automatic. The unit operates directly from available electrical circuits and is equipped with sight gage and stainless steel strainer between pump and tank.

Mechanical agitators can be provided for vertical agitation instead of usual horizontal type. The controlled-capacity pumps are available in simplex or duplex types with spring-loaded, double-ball valves of stainless steel or special alloys. The drive comprises a standard speed reducer and motor assembly. Philadelphia Pump and Machinery Co.

18—OIL CIRCUIT RECLOSERS

Are made with one-way seal to provide increased moisture protection

Units of this new line of oil circuit reclosers are available with a time-current characteristic that allows interchangeability with other makes. The one-way seal, placed around the operating handle

R/M's BIG 7 packing types cover 95% of all packing needs

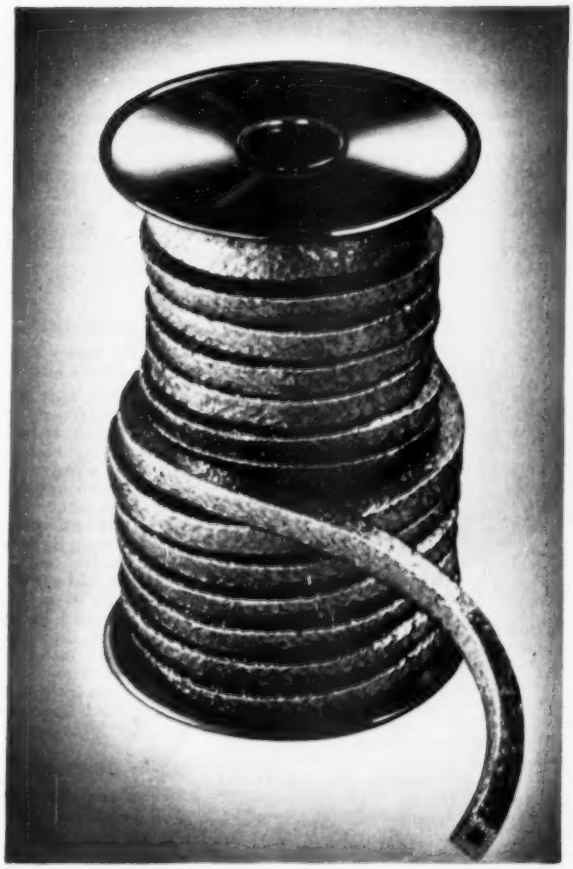
Yes, unless you have extremely rare packing applications, your needs can be met entirely by R/M's new basic line of *just seven* field-tested packing types. Three or four are probably all that you will need to take care of your requirements. Ask your distributor to show you how standardizing on R/M's "Big 7" can lower your inventories, simplify your ordering, reduce your downtime.

Here's the story on TYPE 2

Type 2 Is R/M High Pressure Valve Stem Packing. It comes in two numbers—R/M 303 and R/M 1326-J. Both of these packings have a core of universal plastic packing over which is braided a woven asbestos jacket.

R/M 303 has Monel wire in the jacket. This packing is recommended for valve stems on high pressure and high temperature equipment to 800°F; for pressure equivalents of saturated and superheated steam; for valve stems with Brinell hardness of 400 or better.

R/M 1326-J is non-metallic. It is recommended for steel and non-ferrous valve stems handling temperatures to 800°F. It is excellent for all types of expansion joints.



R/M PACKINGS
RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, MANHEIM, PA.

FACTORIES: Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C.; Passaic, N.J.; Neenah, Wis.; Crawfordsville, Ind.; Peterborough, Ontario, Canada

RAYBESTOS-MANHATTAN, INC., Manufacturers of Packings • Teflon Products • Asbestos Textiles • Industrial Rubber Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks • Clutch Facings • Fan Belts • Radiator Hose • Sintered Metal Products • Bowling Balls

For more data circle 530 on Post Card

shaft of the units, permits the release of internal pressure, it is explained, but prevents moisture-laden air from entering the recloser since all other possible openings are fully gasketed.

It is pointed out that with moisture problems eliminated by the new seal, maintenance is reduced to that required because of oil carbonization and contact burning. The entire line of reclosers includes single- and three-phase units, with 5 to 140 amp current rating, 2400 to 14,000 v, and 125 to 2500 amp interrupting capacity. General Electric Co.

19—WATER SUCTION HOSE

Horizontal braided; is flexible and light in weight

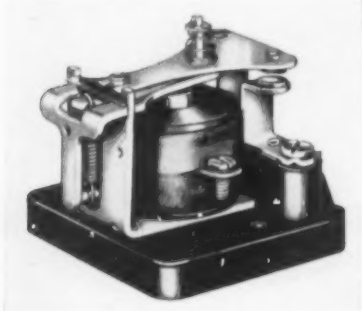
Revolc Water Suction Hose will not kink or collapse, manufacturer states; it maintains full opening in any position and can be grounded to eliminate static electricity. Designed for both pressure and suction handling of water, this hose is reinforced with two layers of braided rayon cord, plus helix of high tensile spring steel wire. Layers of reinforcement are separated by one of rubber friction to eliminate internal chafing of the reinforcing cords and wire. The hose can be connected with any type of suction or water hose coupling and is made available in 1½ in. to 3 in. ID sizes. Quaker Rubber Corp., Div., H. K. Porter Co., Inc.

20—POWER RELAYS

Heavy duty type, redesigned for better insulation, rugged service

This company's redesigned PR Heavy Duty Power Relays have one-piece molded plastic bases with reinforced molded contact support integral with base.

Models PR 1, 2, 3, 5 and 7 (PR 3 is shown) will have molded bases to fit



the same (1⅞ in.) mounting centers as preceding metal base units. Dimensions are 2 9/16 in. by 2½ in. by 2⅜ in. high.

Models PR 4, 8 and 11 have an insulating barrier molded to the base between stationary contacts for increased over-the-surface leakage path, and they fit the same mounting centers as preceding units. Dimensions are 3⅛ in. by 2½ in. by 2⅜ in. high. Bulletin 100 gives further details. Potter & Brumfield.

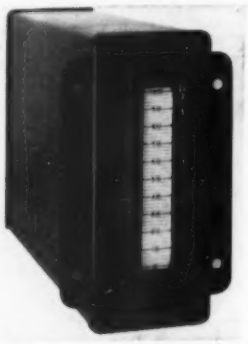
You may use the post cards on pages 37 and 123 to ask for further information on any of these new products

21—INDICATOR

Ribbon-type, designed for graphic panels; with single or dual scales

The Model 50 Consotrol Indicator is designed for panel applications which require continuous indication of valve position or variables such as liquid level.

The instrument fits easily into graphic panel symbols, its scale is only ¾ in.



by 4¼ in. All component parts are mounted on removable chassis and protected by housing secured to back of panel, so that the complete mechanism can be removed from housing for service without disturbing scale or panel.

Available with single or dual indicating scales, the Model 50 can be adjusted for direct or reverse response to measurement. Alarm contacts, mercury switch type, are optional for various combinations of warning signals. The indicator receives pneumatic measurements from transmitter, and this force is applied to receiver bellows which rotates two drums. A brightly colored nylon tape, wound on these drums, is drawn behind a glass pane on which scale graduations are printed. The Foxboro Co.

22—HEAT EXCHANGER

For safety relief valves; is designed to place heat where most needed

An internal heat exchanger available in the manufacturer's nozzle and semi-nozzle safety relief valves, is intended to eliminate steam tracing or steam jacketing a valve where highly viscous lading is encountered. It provides maximum efficiency by placing the heat where most effective, company says.

The unit is designed for incorporation in the valve body without interfering with the rest of the valve mechanism. It consists of a steel coil inserted into the valve and led out to connect with steam line. Coil ends are accessible for return-pipe installation or one-pipe installation with a vent valve. A steam trap drains coils, and the construction is suitable for back pressure. Farris Engineering Corp.

23 — PORTABLE PAGING UNIT

Permits selective paging of maintenancemen, transient personnel

An integral part of this company's new electronic paging system, these portable units can be plugged into a-c power outlets at locations within the building to receive coded paging signals without special wiring. Both audible and visible signals are received.

With this system, personnel customarily paged are assigned code numbers which indicate the cadence in which the individual signal will operate. A code-selecting plug, inserted in the system's central code selector, superimposes high-frequency signaling pulses on regular a-c light and power wiring to sound signals throughout the building. Following the individual's paging code, special signals may be sounded to indicate the reason for paging. International Business Machines Corp.

24 — MOBILE POWER PLANT

Is 500 kw generating unit, no larger than ordinary house trailer

These mobile power plants are being produced to serve as sources of emergency power for state institutions in the event of the disruption or failure of usual power sources. They are also suggested for use as stand-by units for municipalities, industries, and installations requiring large amounts of electricity not available from usual high-line sources.

A standard fifth wheel coupling makes it possible to tow the entire unit with any heavy duty truck tractor. It has an automatic control system, and can be operated by remote control, either by wire or by radio from any reasonable distance. It is designed to reduce the need for servicing, company says, but if service is necessary any mechanic can make the necessary adjustments. Fischer & Associates.

25—AIR-FLOW DETECTOR

Senses and responds to changes or stoppages in air-flow

The Detect-A-Flo can be used as a warning device in air-cooled equipment, a ventilation control, and for applications where a particular flow rate must be maintained. It may also be used as a liquid-level detector or controller in storage and supply tanks. Viscous fluids, which sometimes affect the accuracy of float-type units have little or no effect on the Detect-A-Flo, according to the manufacturer. The instrument is designed to respond to any mass rate of air-flow from 1000 to 50,000 lb per hour per sq ft, and to a change of less than 0.1 in. liquid level.

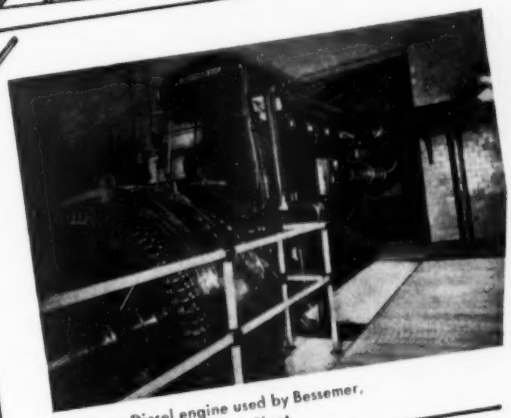
Installation is simple: the Detect-A-Flo is inserted directly in the duct line or tank being monitored, without lead lines or auxiliary fittings. Hermetically sealed, the unit has no moving parts, is repeatable, and is declared to be unaffected by vibration.

The Detect-A-Flo operates on the principle that the amount of heat conducted away from a constant heat source varies with the rate of air-flow moving past that surface. One leg of the unit is continuously heated by a small internal heater. As the flow rate drops, the heated leg expands because less heat is conducted away, and the expansion is transmitted through lever action to a strut-and-electrical-contact assembly in the other leg. This motion relaxes tension in the struts and causes contacts to move apart, thus breaking the circuit.

Because of the "two-legged" design, the unit compensates inherently for any change in ambient temperature within its operating range of −65F to +175F, manufacturer explains. Fenwal Inc.

*Could you make this report about your diesel engine?**

CITY OF BESSEMER, MICHIGAN REPORTS:



Nordberg Diesel engine used by Bessemer, Michigan Municipal Power Plant.

PISTONS PULLED AT 24,600 HOURS!

- All rings were free
- No carbon in ring grooves
- All original rings replaced in original grooves
- Rings should last at least 10,000 more hours
- Maximum cylinder wear was .004 at top, .002 at bottom

OIL CHANGE AT 5000 HOURS!

- No oil added to crankcase between changes
- Power cylinders fed at rate of 5 drops per minute
- Main bearing, rod bearings show very little wear
- Average K.W. per gallon of fuel is 13.5 @ 60% load factor

EXCELLENT

Sam Kalember

Superintendent,
Bessemer Light Utility.

Note:

FOR TOP ENGINE EFFICIENCY, BESSEMER RELIES ON:

Cities Service DC-930 Oil used for crankcase lubrication!

Cities Service DC-230 Oil used for power cylinder lubrication!

* Why not contact your nearest Cities Service Representative or write Cities Service Oil Company, Dept. I-17, Sixty Wall Tower, New York City 5, New York.

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

For more data circle 531 on Post Card

POWER PLANT Construction News

Analusia, Ala. — Alabama Electric Cooperative, Inc., has arranged financing through federal aid in amount of $1,306,000, to provide for construction and installation of equipment in new Diesel-electric generating station, previously referred to in these columns. Work will be carried out soon. Burns & McDonnell Engineering Co., 95th and Troost Aves., Kansas City, Mo., is consulting engineer.

Foley, Ala. — Buckeye Cellulose Co., care of Procter & Gamble Co., Gwynne Bldg., Cincinnati, Ohio, organized as a subsidiary of latter company a number of months ago, plans boiler plant at new dissolving pulp mill at Foley, consisting of several large structures for processing and general production. Cost estimated close to $3,000,000. H. K. Ferguson Co., Clarke Bldg., Birmingham, Ala., is engineer and will be in charge of construction. Work will be placed under way at early date.

Colton, Calif. — Kieckhefer Container Co., 1715 West Canal St., Milwaukee, Wis., fiber and corrugated paper boxes and containers, plans boiler house at new converting plant at 333 West Citrus St., Colton, to consist of a main production unit, 80 x 325 ft. Entire project will cost about $400,000. Smith & Gillespie, 121 East Forsyth St., Jacksonville, Fla., are architects and engineers.

Eureka, Calif. — Pacific Gas & Electric Co., 245 Market St., San Francisco, Calif., plans expansion in steam-electric generating station and facilities at Eurkea, estimated to cost about $9,900,000. Permission has been granted by government to write-off 45 per cent of cost under fast amortization. Project is scheduled to be carried out soon.

Los Angeles, Calif. — Southern California Edison Co., 601 West 5th St., is arranging for a bond issue totaling $30,000,000, proceeds to be used for 1953 expansion and improvement program, including generating plants, power substations, transmission lines and other operating facilities. As recently noted in these columns, plans are maturing for a new steam-electric power plant in vicinity of Long Beach, Calif., to cost over $10,000,000.

Ellaville, Fla. — Florida Power Corp., St. Petersburg, Fla., is reported planning new steam-electric generating stations at Ellaville and Enterprise, respectively, entire project estimated to cost about $14,500,000, including power substations, transmission lines and other operating facilities. Permission to amortize cost with a 30 per cent write-off of total has been granted by Government.

Granite City, Ill. — A. O. Smith Corp., 3533 North 27th St., Milwaukee, Wis., automobile equipment, plans steam power house at proposed new plant at Granite City, for manufacture of steel automobile frames. It will consist of several large buildings on 80-acre tract of land, and will be equipped for heavy output. Entire project is reported to cost about $5,000,000. Work will be placed under way at early date.

Shreveport, La. — Board of Directors, T. E. Schumpert Sanitarium, has plans for new boiler house at institution, with radial brick stack. Work will be carried out in connection with a new incinerator, entire program estimated to cost over $200,000. Neild-Somdal Associates, 960 Jordan St., Shreveport, are architects.

College Park, Md. — Board of Trustees, University of Maryland, will have plans prepared soon for new boiler house for steam-heating service at institution, estimated to cost about $800,000, of which approximately $550,000 will be expended for equipment. Also will extend steam-distribution system at cost of about $150,000. A bond issue has been approved for program.

Waltham, Mass. — Department of Mental Health, Commonwealth of Massachusetts, 15 Ashburton Pl., Boston, Mass., has approved plans for extensions and improvements in power plant at W. E. Fernald School, Waltham, with installation of additional equipment for increased capacity. Work will be carried out soon. Cost estimated about $400,000. Charles T. Main, Inc., 80 Federal St., Boston, is consulting engineer.

Worcester, Mass. — Department of Education, City Hall, is reported planning new boiler house at Boys' Trade School to be erected on Grove St. Entire project is estimated to cost over $650,000. Proposed to begin erection soon. Franklyn R. Williams, 22 Elm St., Worcester, is architect.

Detroit, Mich. — Detroit Sulphite Pulp & Paper Co., 9125 West Jefferson Ave., paperboard products, has approved plans for expansion in power plant at mill, including turbine department and boiler room.

Gladstone, Mich. — City Lighting Dept., will have plans prepared soon for new municipal electric light and power plant, estimated to cost about $2,200,000, with turbine-generator, boiler and auxiliary equipment. A bond issue in amount noted has been voted by citizens at recent special election.

Jackson, Mich. — Consumers Power Co., Jackson, is arranging for a bond issue of $25,000,000, proceeds to be used in connection with 1953 expansion and improvement program, including generating stations, power substations, transmission lines and other operating facilities. Company estimates that it will expend about $60,000,000 in such developments this year.

Fergus Falls, Minn. — Otter Tail Power Co., Fergus Falls, has authorized a note issue of $4,000,000, proceeds to be used for expansion and improvements in power plants and system in 1953, including generating facilities, power substations, transmission lines and other work.

Greenwood, Miss. — Town officials plan boiler house at proposed new local industrial building to be constructed by municipality and occupied under long-term lease by Conmar Products Corp., 140 Thomas St., Newark, N. J., metal slide fasteners, as a new branch factory. Town has voted bonds for $750,000 for plant erection. Work will be placed under way soon.

Horseheads, N. Y. — Koppers Co., Wood-Preserving Division, Koppers Bldg., Pittsburgh, Pa., plans boiler plant at proposed new wood-preserving plant at Horseheads, where tract of about 80 acres of land has been secured. Smoke-abatement equipment and fuel conservation facilities will be installed. Entire plant will comprise several buildings. No official estimate of cost announced — will represent a sizable investment.

Charlotte, N. C. — Duke Power Co., 422 South Church St., is arranging a program of expansion and improvements in power plants and system over a period of months to cost about $94,400,000, including generating facilities, power substations, transmission lines and other developments.

Charlotte, N. C. — Standard Chemical Products, Inc., 1301 Jefferson St., Hoboken, N. J., plans boiler house at proposed new branch plant at Charlotte for manufacture of textile and other chemicals. It will comprise a main processing and production building, and auxiliary structures. Cost reported over $600,000. Work is scheduled to begin soon.

Weaverville, N. C. — Cashmere Corp. of America, Inc., 2765 East 55th St., Cleveland, Ohio, cashmere yarns, sweaters, etc., plans boiler house at new branch mill at Weaverville, where site has been acquired, totaling 33 acres. Entire program to be carried out over a period of months, will comprise several buildings, estimated to cost approximately $500,000, with equipment.

Columbia, S. C. — South Carolina Electric & Gas Co., Columbia, has arranged for financing in amount of $4,000,000, proceeds to be used for extensions and improvements in power plants and system, including generating facilities, power substations, transmission lines and other work.

Jefferson, S. C. — Jefferson Bleachery, Inc., care of Cary C. Boshamer, president, Carolina Corp., Clover, S. C. (knit goods), recently organized by Mr. Boshamer and associates, plans boiler house at proposed new dyeing, bleaching and finishing mill, about 12,000 sq. ft. floor space, at Jefferson, where site has been selected. Proposed to begin work soon. Cost reported about $250,000.

Pasadena, Tex. — Houston Lighting & Power Co., Fannin and Walker Sts., Houston, Tex., is reported planning new power plant in vicinity of Pasadena, to cost about $16,000,000, with power stations, transmission lines and other operating facilities. A certificate of neccssity has been granted by Office of Defense Mobilization, Washington, D. C.

San Antonio, Tex. — San Antonio Public Service Board, 201 North St. Mary's St., has arranged for sale of a bond issue of $10,000,000, proceeds to be used for extensions and improvements in municipal power plants and system, including power substations, transmission and distributing lines, and other operating facilities.

Salt Lake City, Utah — Utah Chemical Co., care of N. G. Morgan, Jr., Wasatch Oil Bldg., Salt Lake City, recently organized by Mr. Morgan and associates, plans power house at proposed new chemical works on site now being determined, comprising a number of large units for manufacture of ammonia, nitric acid and other heavy chemicals. Cost reported over $15,000,000. Application has been made to National Production Administration, Washington, D. C., for an amortization certificate for project.

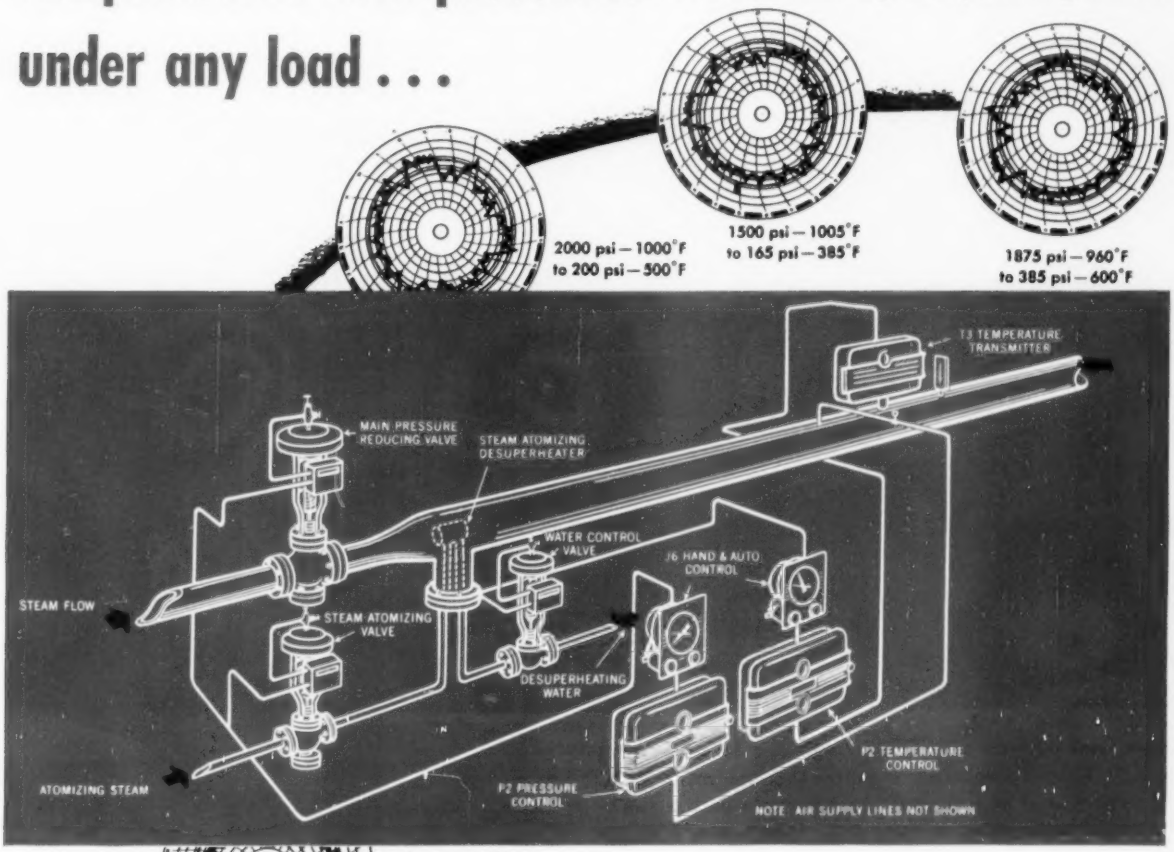
Seattle, Wash. — Kaiser Gypsum Co., 1924 Broadway, Oakland, Calif., a division of Kaiser Industries, Inc., same address, wallboard, plaster and other gypsum products, plans steam power house at new branch plant on tract of land on Duwamish Waterway, Seattle. It will consist of five main buildings for different branches of output, equipped for large capacity. Cost reported close to $4,000,000. Work scheduled to begin soon, with completion by close of 1954.

Sisterville, W. Va. — Linde Air Products Co., Division of Union Carbide & Carbon Corp., 30 East 42nd St., plans power house at new plant in Tyler County, vicinity of Sisterville, for manufacture of silicones. It will consist of several large buildings for processing and production, with installation of electric furnaces and other equipment, and is reported to cost over $10,000,000. Proposed to begin work soon.

Swartwout RDC Systems maintain accurate control of temperatures and pressures under any load . . .

Performance of Swartwout RDC Systems—Reducing, Desuperheating and Controls—is precise and stable under *any rate of change of load of any magnitude.* The pressure and temperature reductions shown are taken from representative Swartwout RDC installations.

In most installations, pressure is held to within ±½#, temperature to within ±3°F or less. Temperature control unit provides wide throttling range with automatic load compensation for close control. Steam atomizing desuperheater gives narrow-angle dispersion of cooling water outside atomizing head. Swartwout reducing valves, with large-diameter stems for long life, have nozzle-shaped passages that minimize turbulence, noise, vibration for longer valve life.



See the Swartwout Display
Booths 144-145
8th National Instrument Exhibit
SHERMAN HOTEL, CHICAGO
September 21-25

50 YEARS Service to Industry The Swartwout Company 1903-1953

No matter how stringent your control requirements, no matter how rapidly load changes—turn your problems in reducing, desuperheating and control over to Swartwout. We have been solving steam problems for over 50 years.

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Swartwout

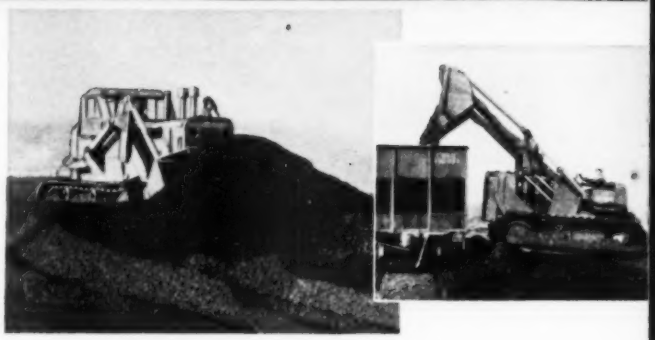
POWER PLANT EQUIPMENT
PROCESS INDUSTRY CONTROLS
INDUSTRIAL VENTILATION

SEND FOR BULLETINS S-21-E, S-22-CA, S-198 & S-100-K • THE SWARTWOUT COMPANY, 18511 EUCLID AVENUE, CLEVELAND 12, OHIO

For more data circle 532 on Post Card

New Trends in Coal Handling

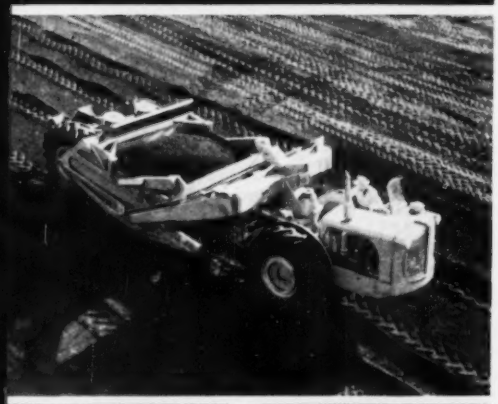
Store Coal 30 Tons at a Time. These two Allis-Chalmers HD-20 Torque Converter Tractors together move 30 to 36 tons of coal at a pass — dozing it out onto a stockpile at a southern power plant and compacting it at the same time to avoid fire by spontaneous combustion. Working as a team, the 41,000-lb. tractors move 15 to 30 percent more coal at a pass than they could both move separately. Two Allis-Chalmers units purchased in 1950 operated so successfully that the utility now has eight working at three plants.



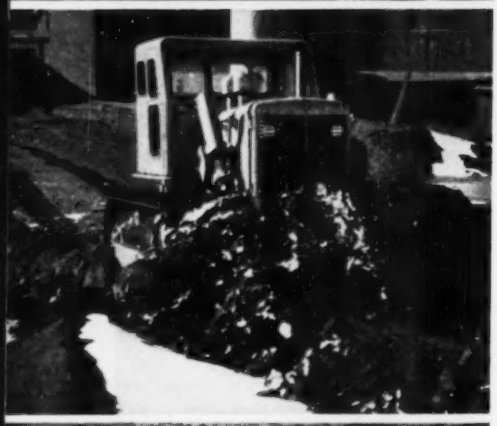
Tractor-Scraper Team Stockpiles Coal Anywhere. Coal brought in by water to Midwest chemical plant is economically hauled to stockpile, spread in 4-in. layers and compacted by Allis-Chalmers HD-20 Torque Converter Tractor and 25-yd. (18-ton) scraper. With tractor-scraper units that travel anywhere, storage areas can be placed wherever space is available, coal piled high if space is limited.

World's Largest Tractor-Shovel Pushes Coal or Loads It. *Above left,* Allis-Chalmers HD-20G with 7-yd. bucket is a big-production unit for moving coal to stockpile and then reclaiming it as needed. *Above right,* the HD-20G is a big-production loader, too. Its 5-ton capacity and 13-ft. dumping height make it ideal for loading hoppers, cars, biggest trucks.

New Special Coal-Handling Blade for HD-20 Torque Converter Tractor is designed to take full advantage of the tractor's big 175 net engine hp., permitting it to move about 15 percent more coal than with regular blade. The unit shown here stockpiling coal for a New York utility moves an average of 14 tons at a pass.



Motor Scrapers Move Coal Fast on Longer Hauls. With 4th-gear speed of 22.5 mph. and heaped capacity of 18 yd. (13½ tons), the Allis-Chalmers TS-300 Motor Scraper efficiently moves big quantities of coal long distances. It compacts well, too, with 47,900 lb. total weight. Has 20 hp. per cu. yd. capacity for bigger loads every trip. The TS-200 Motor Scraper has a heaped capacity of 13 yd. (10 tons).



Flexibility in Tractor Handling of Coal is shown by versatile Allis-Chalmers units. They can either handle all storing and reclaiming of coal—or supplement existing facilities. Storage areas can be added without installing costly conveyors, tracks, etc.—or abandoned without leaving money tied up in idle equipment. The 109-drawbar-hp., 27,850-lb. HD-15 Tractor seen here easily takes care of all storing and reclaiming of coal for an eastern power plant.

HD-9 Tractor Handles Coke for Steel Mill. An Allis-Chalmers 72-drawbar-hp., 18,800-lb. HD-9 Tractor dozes coke out onto stockpile, levels and compacts it, then reclaims it as needed by the plant. Freezing of coke surface in wintertime no longer hinders operation with tractors as it did with previous system.

cuts equipment investment, speeds work with versatile HD-5G Tractor-Shovel

Stockpiles. Allis-Chalmers 40-drawbar-hp. HD-5G Tractor-Shovel pushes coal wherever desired on stockpile at Midwest plant. Also stockpiles cinders.

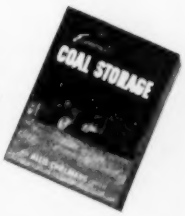
Compacts. With added weight of full loaded bucket, 16,200-lb. HD-5G compacts coal for safety from fire.

Reclaims, Loads. With 2-yd. (1½-ton) bucket and 9-ft. dumping height, the HD-5G efficiently loads coal from stockpile to trucks for hauling to plant. Dozes or carries coal on short hauls. Owner supplies cinders to concrete contractors, finds handling them with HD-5G faster and lower cost than the power shovel formerly used for this purpose.

ALLIS-CHALMERS
TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

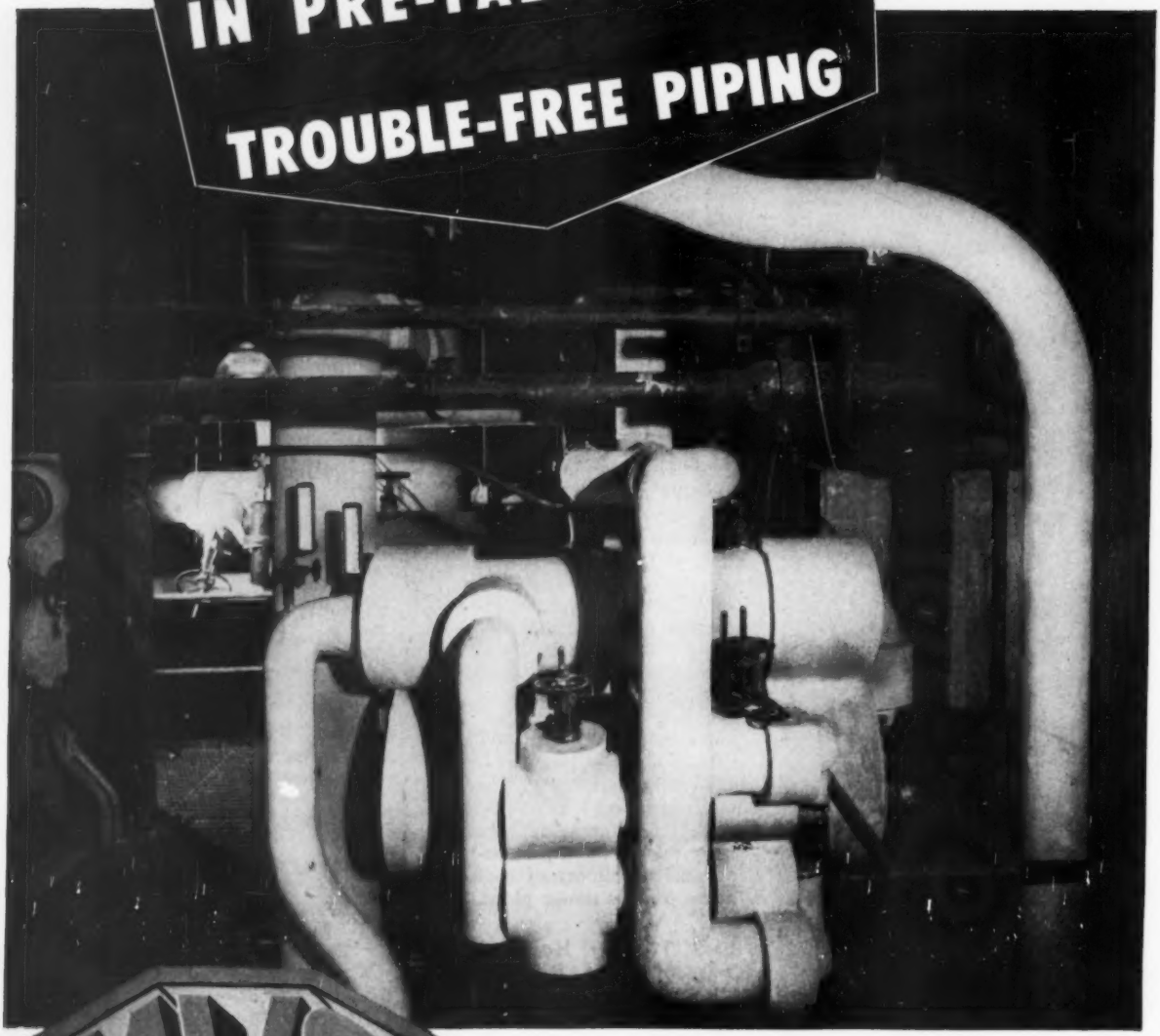
4 TRACTORS • 4 TRACTOR-SHOVELS • 7 SCRAPERS • 2 MOTOR SCRAPERS
2 MOTOR WAGONS • 5 MOTOR GRADERS

Find out more about how Allis-Chalmers equipment can improve coal handling for you. See your Allis-Chalmers dealer for a demonstration right at your plant. Also, send for free booklet, "Economic Coal Storage with Allis-Chalmers Tractors."



For more data circle 533 on Post Card

NAVCO ACCURACY IN PRE-FABRICATION TROUBLE-FREE PIPING



NAVCO

Prefabrication accuracy is an essential "MUST" to assure a proper fit and economical operation. Navco's 40 years' experience in fabricating assemblies in all sizes and for all operating conditions is your assurance of such accuracy.

Consult Navco for your next piping job.

NAVCO PIPING

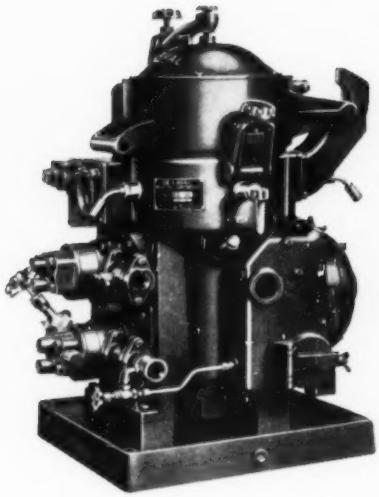
NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA.

NEW YORK • CHICAGO • CLEVELAND • BOSTON • ATLANTA • TULSA • BUFFALO • CINCINNATI

For more data circle 534 on Post Card

NO GETTING AROUND IT!

A De Laval Centrifuge Costs Much Less Than "Down" Time



The cost of a De Laval Centrifugal Oil Purifier of any given size is only a fraction of the cost of the prime mover it protects. There's no denying it, the comparatively modest investment represented by a De Laval Oil Purifier is far outweighed by the cost of even one serious shutdown. A De Laval machine is truly inexpensive insurance.

A De Laval Oil Purifier instantaneously removes from lube oil, all water, dirt or sludge by means of centrifugal force, keeping the oil clean and safe. The water is discharged continuously. Moreover, every De Laval machine correctly selected for size in the first place, has ample reserve capacity to take care of a sudden water leak.

Naturally, any solid contamination is thrown out of the oil and stored out of the zone in which purification takes place.

De Laval protection is *complete* protection!

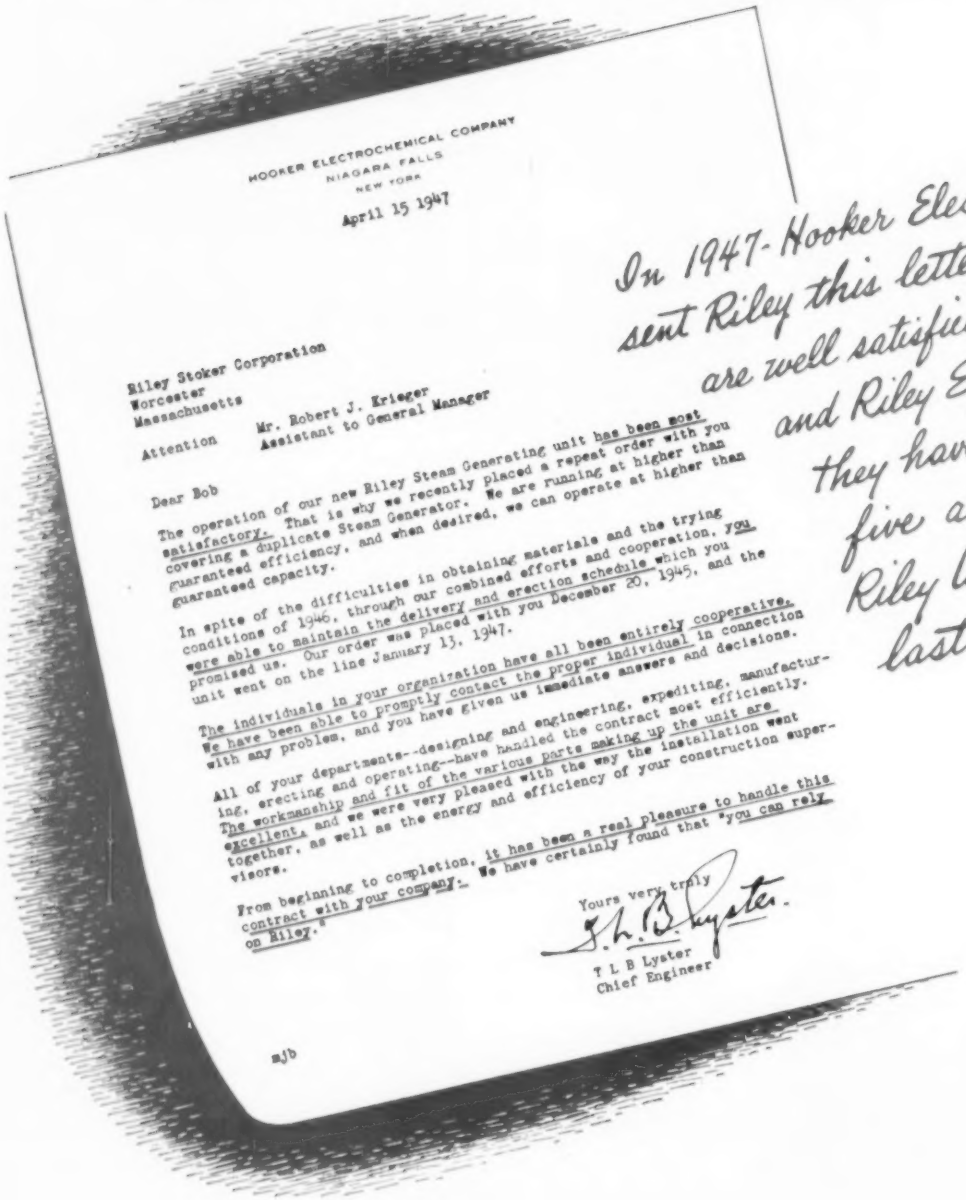
DE LAVAL

THE DE LAVAL SEPARATOR COMPANY
Chicago POUGHKEEPSIE, N.Y. San Francisco

FOR MORE DEPENDABLE POWER PRODUCTION

For more data circle 535 on Post Card

Since their first unit went on the line in 1947



HOOKER ELECTROCHEMICAL COMPANY
NIAGARA FALLS
NEW YORK

April 15 1947

Riley Stoker Corporation
Worcester
Massachusetts

Attention Mr. Robert J. Krieger
Assistant to General Manager

Dear Bob

The operation of our new Riley Steam Generating unit has been most satisfactory. That is why we recently placed a repeat order with you covering a duplicate Steam Generator. We are running at higher than guaranteed efficiency, and when desired, we can operate at higher than guaranteed capacity.

In spite of the difficulties in obtaining materials and the trying conditions of 1946, through our combined efforts and cooperation, you were able to maintain the delivery and erection schedule which you promised us. Our order was placed with you December 20, 1945, and the unit went on the line January 13, 1947.

The individuals in your organization have all been entirely cooperative. We have been able to promptly contact the proper individual in connection with any problem, and you have given us immediate answers and decisions.

All of your departments--designing and engineering, expediting, manufacturing, erecting and operating--have handled the contract most efficiently. The workmanship and fit of the various parts making up the unit are excellent, and we were very pleased with the way the installation went together, as well as the energy and efficiency of your construction supervisors.

From beginning to completion, it has been a real pleasure to handle this contract with your company. We have certainly found that "you can rely on Riley".

Yours very truly
T L B Lyster
Chief Engineer

mjb

In 1947- Hooker Electrochemical sent Riley this letter. They still are well satisfied with Riley and Riley Equipment- they have ordered five additional Riley Units- the last in 1952.

TRADE MARK Rx REGISTERED

RILEY

STOKER CORPORATION, WORCESTER, MASS.

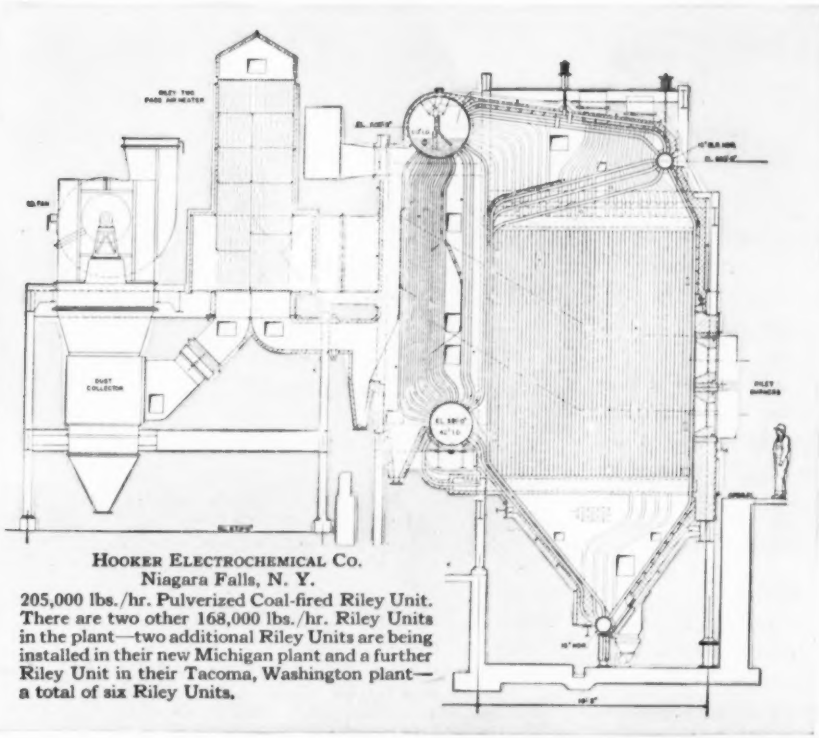
Boston New York Philadelphia Washington Buffalo Pittsburgh Cleveland Detroit Chicago
Cincinnati Charlotte Atlanta New Orleans St. Louis Kansas City St. Paul Tulsa Houston
Denver Salt Lake City Los Angeles Portland Seattle

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • ECONOMIZERS

Hooker Electrochemical have ordered five more RILEY Units . . .

RILEY boiler users have with gratifying regularity repeated for more Riley units when installing additional steam-generating units. The accompanying tabulation lists but a few of the companies which have repeatedly placed orders for Riley units. This refusal of Riley users to accept something almost as good tells a significant story of the satisfactory performance of Riley units.

The good engineering and distinctive design characteristics of Riley units assure high operating efficiency, dependable trouble-free operation over long periods with negligible maintenance. Users of Riley equipment know you can rely on Riley. It will also pay you to thoroughly investigate Riley equipment when installing additional boilers.



HOOKER ELECTROCHEMICAL CO.
Niagara Falls, N. Y.
205,000 lbs./hr. Pulverized Coal-fired Riley Unit. There are two other 168,000 lbs./hr. Riley Units in the plant—two additional Riley Units are being installed in their new Michigan plant and a further Riley Unit in their Tacoma, Washington plant—a total of six Riley Units.

This record of repeat orders for Riley Units is sound proof of the dependability of Riley Equipment

CELANESE CORP. OF AMERICA 15 Orders
DOW CHEMICAL COMPANY 13 Orders
CARBIDE & CARBON CHEMICAL 13 Orders
ALLIS CHALMERS MFG. CO. 6 Orders
CENTRAL OHIO LIGHT & POWER CO. 6 Orders
GULF POWER COMPANY 4 Orders
CENTRAL ILLINOIS LIGHT CO. 5 Orders
HOUSTON LIGHT & POWER CO. 9 Orders
ESSO STANDARD OIL CO. 7 Orders
IOWA-ILLINOIS GAS & ELECTRIC 5 Orders
INTERSTATE POWER CO. 5 Orders
KENNECOTT COPPER CO. 6 Orders
MASONITE CORP. 6 Orders
PUBLIC SERVICE CO. OF INDIANA 4 Orders
SHELL OIL COMPANY 7 Orders
U. S. STEEL CO. 10 Orders
SWIFT & COMPANY 10 Orders
STANDARD OIL CO. OF CALIFORNIA 12 Orders
OTTER TAIL POWER CO. 6 Orders
OHIO EDISON CO. 4 Orders
CURTISS-WRIGHT CORP. 7 Orders
PUBLICKER INDUSTRIES 4 Orders
CONTAINER CORP. 4 Orders
BEECHNUT PACKING CO. 4 Orders
GAYLORD CONTAINER CO. 4 Orders
MONSANTO CHEMICAL CO. 4 Orders

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

WATER COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

For more data circle 536 on Post Card

Reduce Solids Concentration *with* EFFECTIVE BLOWDOWN

ALLIS-CHALMERS WATER CONDITIONING
Equipment — Chemicals — Service

COMPLETE TEST KITS for making standard feedwater and boiler water tests are supplied by Allis-Chalmers for field use. When needed, modern testing equipment and research facilities are available in A-C laboratories.

You Need An Effective blowdown schedule to reduce solids concentration and limit heat losses in your system. Planning your schedule is easier after you've read Allis-Chalmers water conditioning Bulletin 53. It tells how to choose between a manual and a continuous system. It explains factors involved in sludge removal. And it discusses effects of alkalinity and silica concentration.

Part of Practical Library

Bulletin 53 is one of a series of Allis-Chalmers bulletins on water conditioning problems. These bulletins are the result of Allis-Chalmers experience in solving water problems for every industry, as well as the company's long background in the design and manufacture of steam turbine and power plant equipment.

Get Complete Service

Allis-Chalmers offers complete water conditioning service. You can get analyses and reports on your problems. You can get chemicals needed in all water treatments. And you can get equipment needed for any system.

For your copy of Information Bulletin 53 on blowdown, write Allis-Chalmers, Milwaukee 1, Wisconsin. Or better, call your nearby A-C district office to have an Allis-Chalmers representative consult with you on your water problems.

A-4008

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

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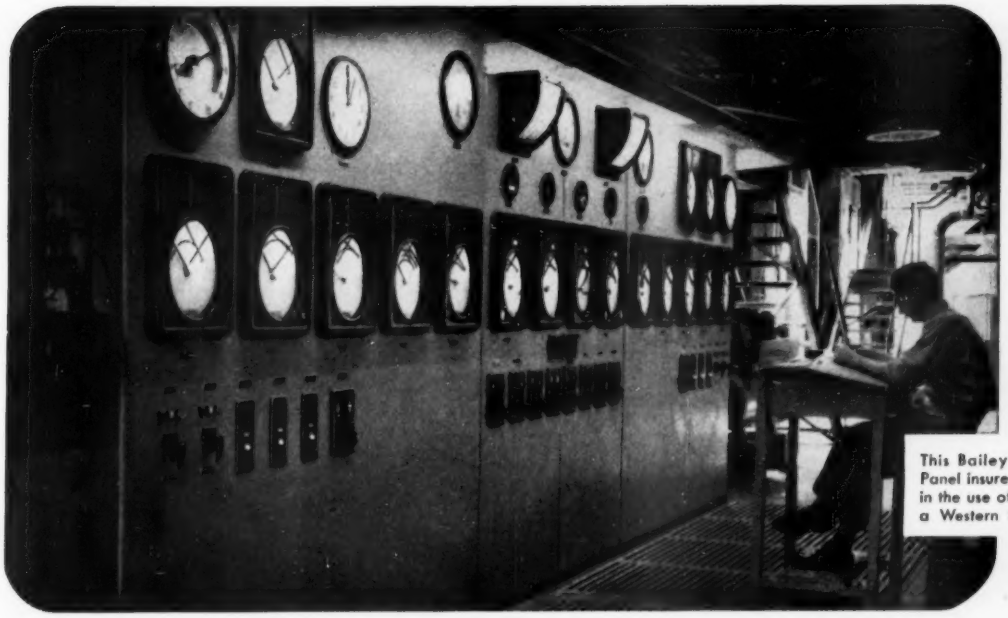

This Bailey Boiler Control Panel insures high efficiency in the use of Fuel-Dollars at a Western Chemical Plant.

What's Your Fuel-dollar Efficiency?

A dollar's worth of fuel has the *same potential* energy, no matter who's boiler it fires. But how much of the energy actually gets converted to a usable form depends on how you operate your boiler.

That's where Bailey Controls can help. And, here's why, we believe, you'll get better fuel-dollar efficiency with Bailey:

1. **Complete Range of Equipment—fully co-ordinated.** You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. **Engineering Service—backed by experience.** No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement and automatic control.

3. **Direct Sales-Service—conveniently located near you.** Bailey Meter Company's Sales-Service Engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

•

For better fuel-dollar efficiency—for more power per fuel-dollar, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More power to you!"

A-109-1

BAILEY METERS

BAILEY METER COMPANY

1040 IVANHOE ROAD
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Controls for Steam Plants
COMBUSTION · FEED WATER
TEMPERATURE · PRESSURE
LIQUID LEVEL · FEED PUMPS

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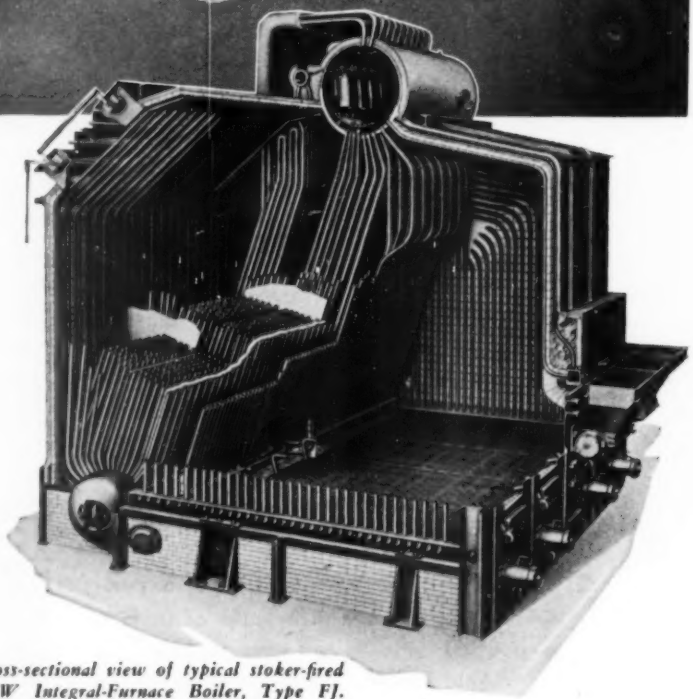
Shown observing combustion conditions in one of Maywood Chemical's new B&W Integral-Furnace Boilers, Type FJ, Frank Green, Chief Engineer, reports complete satisfaction with their performance . . . verifies fuel savings up to 25%.



Cross-sectional view of typical stoker-fired B&W Integral-Furnace Boiler, Type FJ. Suitable for coal, gas, and oil firing, it is available in a steam capacity range from 30,000 to 70,000 lb per hr at pressures to 800 psi. For a detailed description of design and operating features, write for Bulletin G-70. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

2 B&W Integral-Furnace Boilers CUT COSTS $300 PER OPERATING DAY

at

MAYWOOD CHEMICAL WORKS

To assure a constant and reliable steam supply under conditions where demand varies between 35,000 and 100,000 lb per hr, Maywood Chemical Works recently placed in service two stoker-fired B&W Integral-Furnace Boilers, Type FJ. These units replaced eight old boilers that were not producing steam efficiently or in sufficient quantity to meet plant requirements. Each new boiler has a design capacity of 55,000 lb per hr at 150 psi, and is designed to burn oil from a side wall, without disturbing the stokers now in use for coal firing. As a direct result of the change-over, steam capacity is up, while fuel, operating labor, and maintenance costs are reduced by substantial amounts . . . fuel savings alone are estimated at between 20 and 25%.

Concerning performance of the new B&W Units, Mr. Frank Green, Chief Engineer of Maywood Chemical is enthusiastic. "Boiler response is excellent . . . as high as 50,000 lb per hour in a minute for the two units. Cheaper grade of fuel is burned efficiently and steam pressure is steady and continuous. Although boilers are equipped with soot blowers they are not needed and are not used. Our previously serious fly-ash problem has been substantially reduced."

After installation plans were made by Maywood's consulting engineers, A. Wilson and Co., B&W took over the complete boiler erection job. B&W service engineers then started up the boilers for a thorough operational check before turning them over to Maywood Chemical as complete, efficient, in-service units.

COST SAVING FEATURES

of B & W Integral-Furnace Boilers for Steam Requirements from 2,800 to 350,000 Lb. Per Hr.

- Minimum floor space and headroom requirements
- High fuel economy
- Smokeless combustion
- Adaptable to all fuels and firing methods
- Economical fast steaming
- Water-cooled furnace
- Clean, dry steam at all ratings, even with high boiler water concentration
- Quick response to wide and heavy load swing demands
- Easy to inspect and clean
- High availability with least attention

BABCOCK & WILCOX

G-599

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IT FLOATS ON THE LOAD! *

You turn on the steam.

This little stainless steel valve—the only moving part in the Yarway Impulse Steam Trap installed on the equipment—opens wide and *stays* open as the air and condensate continuously pour through.

The equipment reaches production temperature in the quickest possible time.

Production temperature reached, the little valve snaps shut. After that, by a pulsating action, it discharges all condensate as it forms—even a tiny teaspoonful. *There's hot steam in the equipment all the time . . .* steady, maximum temperatures are maintained.

It all adds up—to more production per day.

Other profit-making features of the Yarway Impulse Steam Trap—low initial cost, easy installation, stainless steel construction, low maintenance, good for all pressures, quick delivery from over 200 local industrial distributors.

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For free Yarway Impulse Steam Trap Bulletin T-1740, write . . .

YARNALL-WARING COMPANY
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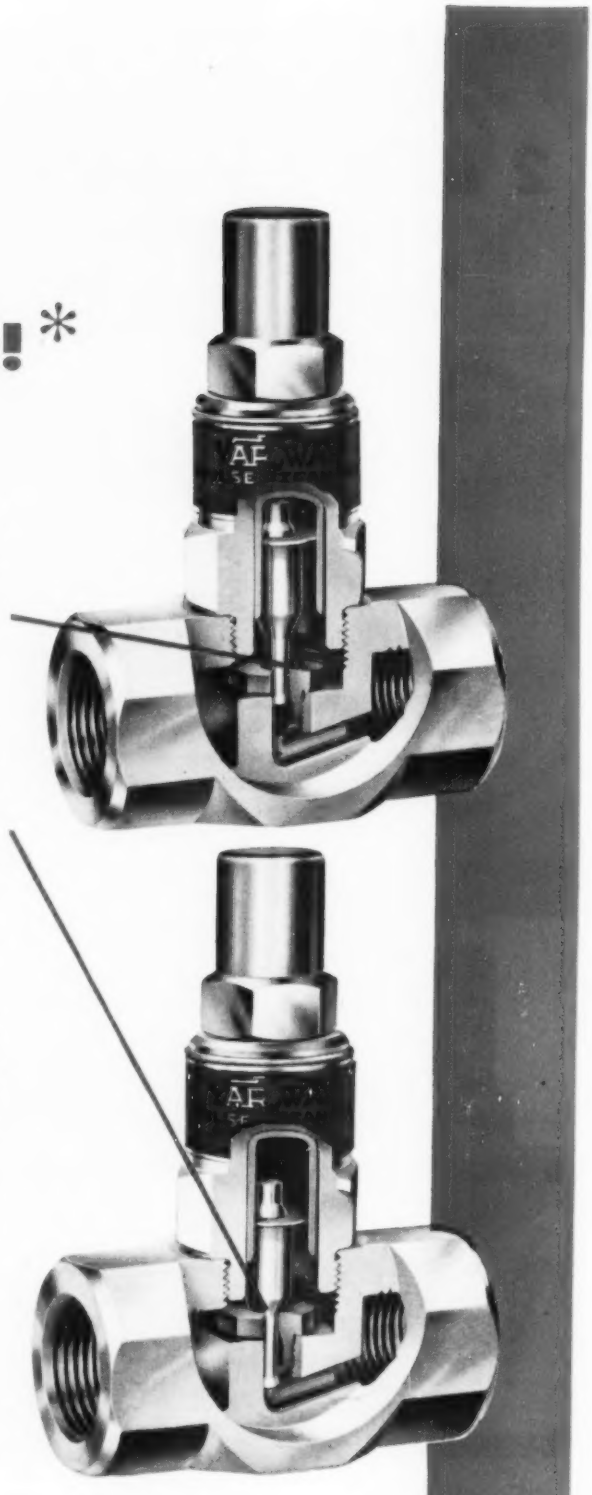

* *. . . resulting in fast heat-up of equipment, more production per day.*

YARWAY | impulse steam trap

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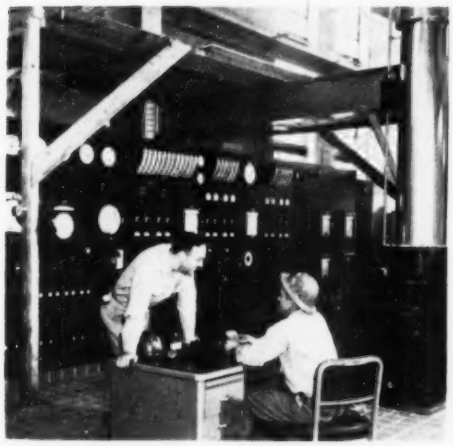
Fig. 1.—Right. General view of Justin R. Whiting Plant of Consumers Power Co. in Southeastern Michigan just north of Toledo. At lower left, coal crusher house and coal conveyor belt to plant. At lower right, circulating water discharge tunnel crossing over intake, located in bay as in Fig. 6

Fig. 2.—Below. Boiler control panel, No. 1 boiler, on operating floor; pulverizer feeder at right



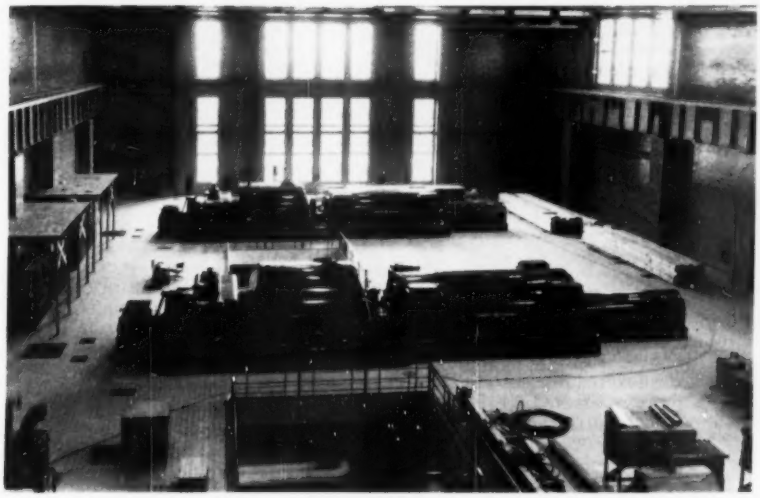


Fig. 3. View of the Whiting turbine room during construction, showing the first two 85,000-kw hydrogen-cooled turbine generators. Third unit of 106,000-kw capacity now being added

Fig. 4. View of firing aisle during early operation. Pulverizer feeders in center; two lower rows of burners appear at right

Careful Attention to Detail Marks New Whiting Plant

By J. W. MACKENZIE

Electric Production Supervisor, Consumers Power Co.

Unusual cross-over of circulating water intake and discharge; expandable coal-handling system; no freight elevator; omission of central boiler-turbine control room; building construction to reduce painting; short power leads and heater piping; special ventilated locker room; exhausters for coal conveyors; different design of circulating water screens — features of new Justin R. Whiting plant in Michigan

For How and Why, Turn the Page ➙

Fig. 5. Map of Michigan showing Consumers Power Co. system and location of its steam power plants

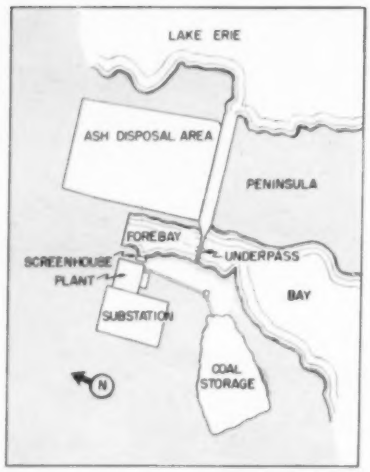


Fig. 6. General layout, Whiting plant, showing how circulating water passages avoid dredging

SOON AFTER purchase of the Citizens' Light and Power Co. of Adrian, Mich. by Consumers Power Co. in 1938, it was evident that the development of electric service in the new territory, together with the growth of load in the southern part of the system, before many years would require additional generating capacity beyond the economical possible development of the then owned plant sites. Studies also showed that to maintain a proper balance of generating capacity in the various parts of the system, at least a portion of the added plant capacity should be located in the southeastern part of the state. Accordingly, in 1941 a plant site was purchased on the shore of Lake Erie about 4½ miles north of the Michigan-Ohio state line as in Fig. 5.

In 1949, rather earlier than had been anticipated, it was evident that power requirements would call for the first unit of this new plant to be in service before the Fall of 1952, and dredging operations in preparation of the site for a new plant were started that Fall.

Features of Plant Site

This plant, named the Justin R. Whiting plant, is located at the north end of what was a shallow marshy bay or lagoon, which is about 4 miles long north and south, and varies from a few hundred feet to more than a mile in width. This bay is formed by a long narrow peninsula, joined to the mainland at the north, and extending southward.

Shallow water extends out into Lake Erie for a long distance in this region, and wave action rapidly would fill a dredged channel. Therefore, as shown in Fig. 6, an arrangement was adopted to take cooling water from the bay and discharge it into the lake.

This necessitated dredging a long intake channel through the length of the bay where the peninsula would protect it from the ice and wave action from the lake, and necessitated bridging the intake with the discharge duct to return the water to the lake.

Location of the plant at this site not only fitted into a balanced system development, but also had the advantage of ample water for any desired expansion. Good rail service was available, and the plant's proximity to Toledo offered lowest freight rate and hence lowest coal costs of any plant on the system. In addition, an interconnection with the Detroit Edison Co.'s lines at the extreme southern part of their system was made possible, which was mutually beneficial to the service of both companies.

By the time actual design was started it was evident that load growth would require two turbine generator units to be installed in the first step. Studies also resulted in the adoption of a steam pressure of 1450 psi at the turbine throttle with the reheat cycle, using 1000 F initial steam temperature, reheated after the high pressure section of the turbine to 1000 F before entering the intermediate pressure section of the unit.

Months before the first unit was ready for operation, system load had increased so that plans were started for the third unit (a 106,000-kw machine), now under construction.

General Plant Arrangement

The plant building consists of a steel and tile structure with a dark-red exterior face tile and the interior wall surfaces above the operating floor made up of a buff-colored glazed tile. This makes a pleasing appearance, but was chosen principally to eliminate wall painting and thus reduce maintenance.

The boiler room section is on the east side, which is toward the lake, with the basement floor level 13 ft below grade. Below the operating floor there are no continuous division walls between the boiler and turbine sections of the plant, the only walls being those serving as electrical conduit envelopes. Above the operating floor, as shown in Fig. 7, a 22-ft wide bay separates boiler room and turbine room. Two floor levels of this bay are used for the 480-v and 2400-v station power switch rooms. Operating floor level for both the turbine room and boiler room is 21 ft above grade.

Ventilated Lockers

Basement and first floor section of the office part of the plant adjoin directly to the front of the plant. The basement level of this section includes the machine shop and ample storage space for heavy materials. The first floor section, which is about 3 ft above grade, serves as a receiving room, stock room for all but heavy materials, and the main locker room, toilets and showers.

Sufficient lockers are provided so that all men who are doing dirty work have two lockers, one for clean clothes and one for working clothes, and all lockers are connected to a ventilating system which draws air through the lockers for ventilation and drying of damp clothing.

Second and third floors of the office section leave a 20-ft open space between rear of offices and front of plant, except for a central corridor connection from these floor levels to the plant. This arrangement allows window lighting of the office section from all sides, and the separation eliminates practically all plant noise from the offices.

The second floor, at the level of the plant operating floor, is made up of a conference room, plant laboratory, and offices for the clerk and plant supervisors. The third floor furnishes a large assembly room with a rather small but efficient kitchen. These facilities are provided for plant meetings and employee social functions. It is not expected at present that regular restaurant service will be maintained, but these facilities will be available for special occasions.

Designed on Unit System

With the reheat cycle, the plant is, of course, built on the unit system with a single boiler of 690,000 lb per hr steaming capacity per turbine. Each boiler is provided with automatic combustion control, and is designed for 1650 psi with 1480 psi at the superheater outlet. Initial and reheat steam temperature of 1000 F are both controlled by spray attemperators. This temperature control is automatic. Designed as a unit system, no valve is provided between the boiler and the turbine stop valve.

Boiler Details

Each boiler has 4 pulverizers with 3 turbulent burners per pulverizer. Burners for each pulverizer are arranged at one level across the front of the furnace; two rows are located

Fig. 7. General cross-section of Justin R. Whiting plant. Note how location of auxiliary transformer and station power rooms keeps leads short, also how heaters are arranged. Two 85,000-kw units now installed as shown in the photo of Fig. 3

just above the operating floor and two rows at a higher elevation. At partial loads, when the superheat tends to be low, the upper burners are used because they are nearer the superheaters, and the additional capacity for full load is picked up by the lower burners when the steam temperature tends to be high, with the spray attemperators for final control as mentioned above.

Cross section of the boiler included in Fig. 7 clearly shows the arrangement of superheater, reheater, economizer and air preheater. Upper section of the air preheater is made up with aluminum tubes, which, it is expected, will reduce corrosion and plugging. Tube size and spacing also is varied to maintain the gas velocity with the cooler gases.

Each boiler is provided with one forced-draft fan and one induced-draft fan, with speed controlled by hydraulic couplings. They are located in the fan room above the boilers. This location of the forced-draft fans assures warmest air to these fans, usually above 100 F even in winter, and assures good ventilation. To avoid possible condensation from flue gases in the air preheater, when operating at partial loads, provision is made for recirculation of part of the air from the preheater, to further increase air temperature at entrance of forced-draft fans.

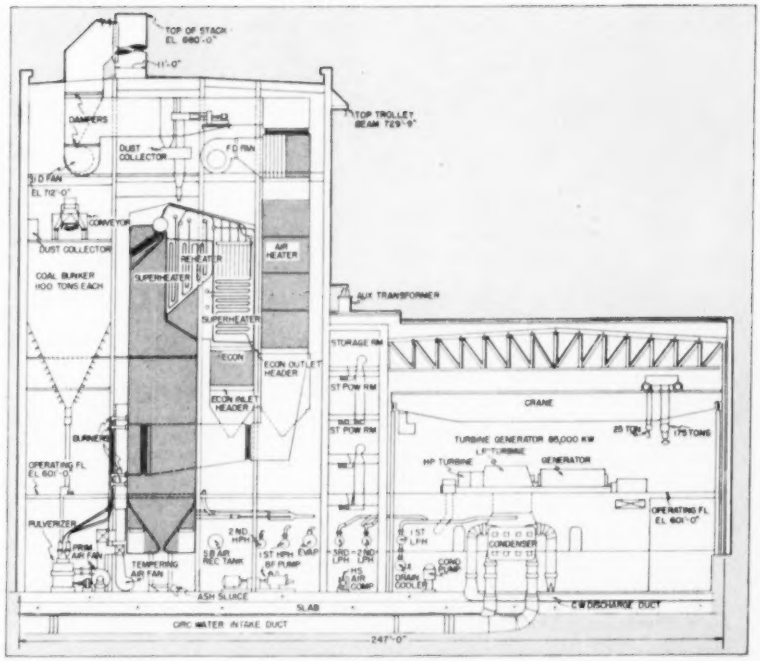
Each boiler also is equipped with mechanical fly ash collectors, between air preheater and induced-draft fan, with provision for continuous removal of the ash by a sluicing system. Water for this system is the waste from water-cooled bearings and coolers on the variable speed couplings.

Turbines and Condensers

First two turbines, cross section shown in Fig. 9, are each 85,000-kw rated capacity, 3600-rpm, tandem-compound machines, designed to receive steam at 1450 psi, 1000 F at the throttle. After passing through the high-pressure section of the turbine, the steam is carried back to the reheater section of the boiler, where the temperature is brought up again to 1000 F, at which it enters the intermediate section of the turbine. This section discharges into the double-flow low-pressure section, which in turn exhausts direct to the condenser.

Condensers of a special deaerating type are spring supported, and are welded direct to the turbine exhaust. They are double-flow with divided water boxes, the tubes being 1-in. Admiralty metal 24 ft long. The hot-

Fig. 9. Detail cross-section through tandem-compound reheat turbine of first two units. Design with high-temperature leads concentrated between high and intermediate pressure sections



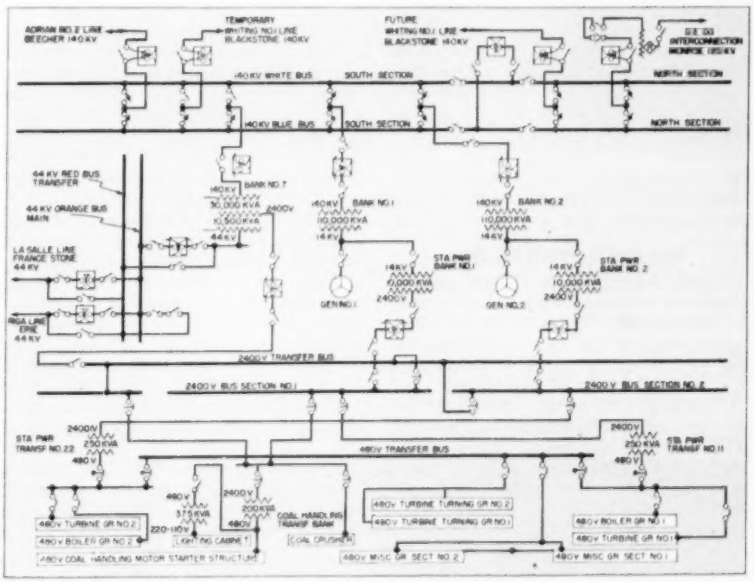
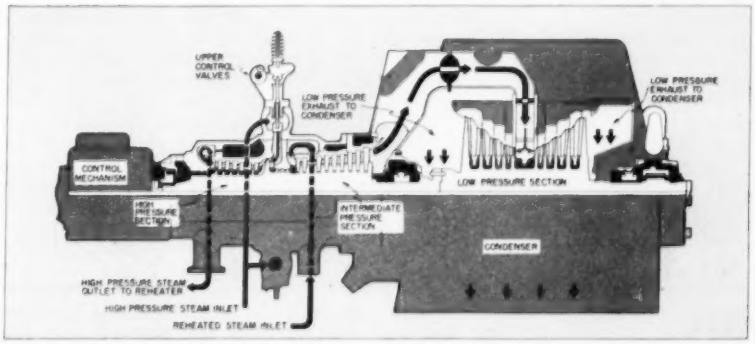

ADRIAN NO 2 LINE BEECHER 140 KV
TEMPORARY WHITING NO 1 LINE BLACKSTONE 140KV
FUTURE WHITING NO 1 LINE BLACKSTONE 140KV
140 KV WHITE BUS
SOUTH SECTION
NORTH SECTION
140KV BLUE BUS
44 KV RED BUS TRANSFER
44 KV ORANGE BUS MAIN
LA SALLE LINE FRANCE STONE 44 KV
RIGA LINE ERIE 44 KV
BANK NO 7
BANK NO 1
BANK NO 2
GEN NO 1
GEN NO 2
STA PWR BANK NO 1
STA PWR BANK NO 2
2400 V TRANSFER BUS
2400 V BUS SECTION NO 1
2400 V BUS SECTION NO 2
STA PWR TRANSF NO 22
480 V TRANSFER BUS
STB PWR TRANSF NO 11
480 V TURBINE GR NO 2
480 V BOILER GR NO 2
LIGHTING CABINET
COAL HANDLING TRANSF BANK
COAL CRUSHER
480 V TURBINE TURNING GR NO 2
480 V TURBINE TURNING GR NO 1
480 V BOILER GR NO 1
480 V TURBINE GR NO 1
480 V COAL HANDLING MOTOR STARTER STRUCTURE
480 V MISC GR SECT NO 2
480 V MISC GR SECT NO 1

Fig. 8. Single-line electrical diagram, Whiting plant. All switching under load on high-tension side



well section of the condenser is made extra large with condensate level control, with a normal water capacity of 3450 gal, which serves as a surge tank supply for the boiler feed pumps. If the hot well level drops, the level control opens a valve admitting water from the 88,000-gal clear well located in one corner of the basement. If the hotwell level rises above normal, a valve opens, allowing water from the condensate pump discharge to be diverted to the clear well.

The clear well, a rectangular steel tank, is divided, with valved pipe connections so either half can be closed off. In normal operation, one-half of the clear well is kept full of pure water, fluctuations being taken in the other. If a condenser leak should develop, it is possible to confine the clear well contamination to the one side and, as soon as the trouble is corrected, the service can be transferred to the other clear well, the contaminated clear well cut out of service and drained, thus maintaining best boiler water conditions.

C-W Discharge Bridges Intake

Condenser cooling water, as stated before, is drawn from the bay into a forebay in front of the screen house. Steel racks with 2½ in between bars, protect the 400-sq ft conduits where the water passes under the discharge duct. These racks prevent large objects in the water from entering the forebay. Power-operated rakes are provided for cleaning these racks. A second set of racks having 2-in. spacing is located in front of the screen house.

Special Screen Design

Screens are of a special design that has been standard with this company for a number of years. This design provides a wider space between the up and down sections of the screen by using two head-shafts and two tail-shafts. The screen unit is turned at right angles to the normal setting, Fig. 10, and the screen house structure is built so that the space between the up and down sections of the screen is sealed on the river side but open toward the pump side.

With this arrangement, the water passes only once through the screen, and greater screen area is utilized for a given depth. Principal advantage, however, is that crayfish, or heavy quantities of grass or weeds that are not washed off the screen by the cleaning sprays, cannot be washed off by the flow and carried into the condenser. This type of screen and structure is rather special, but results have shown it to be well worth while for these plants, and the cost per square foot of active screen area is a little cheaper than the usual arrangement.

Two vertical circulating and two vertical house service pumps for each unit are located in the screen house, which is separate from the plant. Provision is made for dry chlorine gas to be fed to the suction of each of these pumps when needed, to keep the condensers and house service system free of algae.

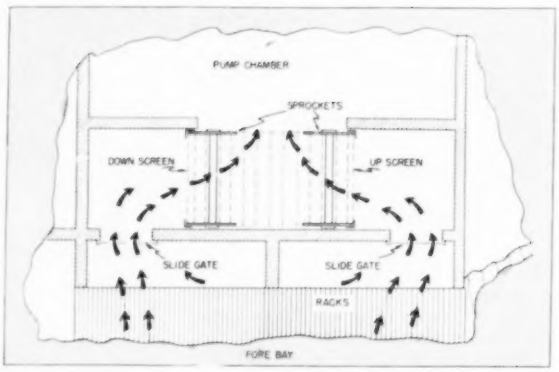


Fig. 10. This type of circulating water intake screen used at Whiting has wide spacing between shafts, is turned at right angles to normal, and is sealed on river side but open on pump side. This arrangement prevents washing dirt into pump chamber, also costs a little less

Separate ducts carried below basement floor level conduct the cooling water for each unit to the inlet water boxes of the condensers. Discharge from the condensers also is carried below the basement floor level in ducts that discharge in a large tunnel below the substation outside the turbine room wall. This tunnel continues past the front of the plant and across the inlet, Figs 1 and 6. Beyond the forebay, in Fig. 1, the discharge tunnel opens into a concrete structure equipped with gates, which permit recirculating any or all of the water to the intake bay, or it can be discharged through an open channel to the lake. Since the vacuum obtained with about 40 F cooling water shows the highest economy, sufficient recirculation is used in winter months to maintain this temperature. This also insures freedom from ice troubles.

Coal is received by rail; ample sidings handle both loaded and empty cars. The ultimate design provides for installation of a car dumper, two Bradford-type breakers, a system of yard belts with stacker and reclaiming crane, with bulldozers and carryalls for distributing, packing and reclaiming coal beyond the reach of the stacker and crane. For the present installation, however, it was found more economical to defer the high cost of this development by installing a car shake-out and track hopper, together with a system of belts.

Coal and Ash Handling

Part of the belts are in tunnels and part above ground, arranged so that coal either can be delivered through a 450-ton-per-hr ring crusher to the plant, or to an initial storage pile, from which it is distributed and packed by bulldozers. The same mobile equipment is used to reclaim coal, delivering it to a hopper that discharges onto the belt going to the crusher. Present storage capacity is 190,000 tons, with the ultimate design capable of storing 1,000,000 tons.

Not only was it more economical to defer the car dumper and Bradford breakers, but the adopted plan will insure two possible means of coaling the plant when the complete coal handling system is provided, which probably will be with the fourth unit addition. While present coal handling capacity is 450 tons per hour, conveyors and equipment are designed so they can be increased readily to feed 800 tons per hour to bunkers and the ultimate unloading capacity will be at least 1,000 tons per hr.

A 65-ton diesel-electric locomotive is provided for handling coal cars and moving them over the unloading hopper. To facilitate handling frozen coal a transite-covered thawing shed 180 ft long is provided over one of the coal supply tracks. Heat is furnished by a series of 6 oil fired thawing pits, 157 ft total length, between and below the track rails. Each pit is supplied with 8 electrically ignited oil burners, which can be started individually and controlled from outside the shed.

Conveyor System Exhausters

Feeders to the coal belts, all transfer points, the coal crusher, and the belt tripper which travels above the bunkers, are enclosed fully and connected to an exhauster fan system to collect the dust, thus aiding greatly in keeping the system clean. Likewise the bunkers are entirely enclosed, with a flexible seal between the bunker and the tripper. Exhaust fans also maintain a slight suction in the bunkers. All these exhausters discharge through dust collectors.

Coal is weighed accurately by automatic belt scales as it is delivered to the bunkers, while coal meters, installed in the pipe supplying coal to each pulverizer feeder, are used for calculating daily results. While the coal meter is not an accurate measuring device, the results are checked carefully every few days and the meter constants adjusted slightly as necessary to make their results of total coal agree with the automatic belt scales. This system has been found quite satisfactory.

Switching and Auxiliary Power

From Fig. 8 it will be noted that no oil switch is provided between generator and main transformer, which steps the voltage up from

(*Continued on page 106*)

Fig. 1. This pipe covering is easy to apply. It is lifted from the carton, opened like a book, and clamped over pipe. Light on workman's wrist shows simple motions in applying it

Photos by Harold Corsini, Pittsburgh Photographic Library

For Tough Jobs: Foil-Covered Pipe Insulation

Goes on Fast, Cleans Well, Takes Hard Knocks and Is Low in Maintenance Cost

FOAMGLAS wrapped in aluminum and packaged for use direct from the carton is Pittsburgh Corning's latest development. It is completely aluminum jacketed, formed in halves, book-hinged at one joint. Installation is simple:— Remove from the carton, open like a book, clamp over the pipe and install the bands. The photographs show the sequence of operation; the light fastened to the wrist of the workman in Fig. 1 shows the directness of application. If the lines are cold, say 50 F or below, there is one additional step: Both the butt and longitudinal joints should be buttered with a mastic sealer, as shown by Fig. 2. This insures water-tight joints and prevents migration of moisture behind the insulation. The finished job is shown by Fig. 3. This new insulation is available in 18-in. lengths, for pipe sizes from ¼ to 14 in., and in thicknesses of 1, 1½, 2, 2½, 3 and 4 in. to meet various installation requirements. The aluminum jacket adds to the thermal qualities of the FOAMGLAS and gives ease of cleaning and improved impact resistance for tough, rugged jobs, for speed, appearance, insulating qualities and low maintenance.

WANT MORE INFORMATION?

If you do, write the Editor, or use one of the postage-paid cards elsewhere in this issue. Just write "Pipe Insulation" at bottom of card.

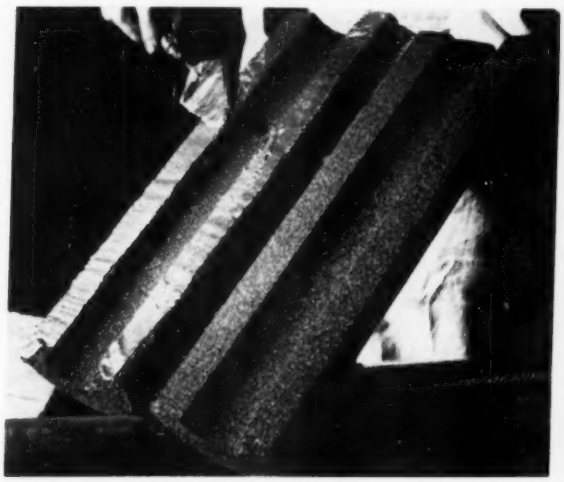


Fig. 2. When this new pipe covering is applied to cold lines, the longitudinal and butt joints are buttered with a mastic sealer to render them water-tight

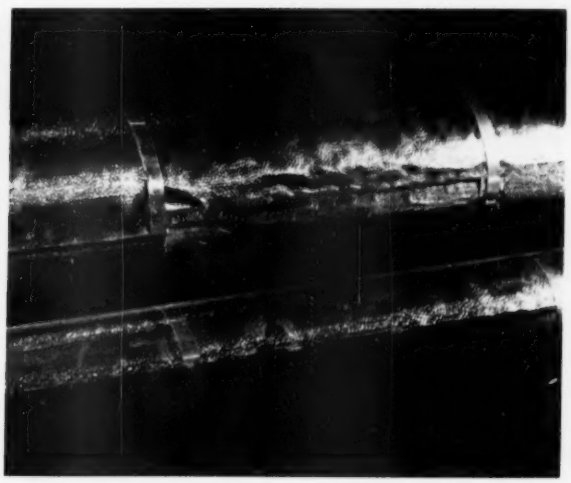


Fig. 3. Besides presenting an unusually neat appearance of the finished job —a factor of growing importance—the foil cover adds insulating value

How We Teach

No one knows who will be there when fire breaks out, so this school has trained them all. Janitors and rear admirals alike have taken the course

By W. E. ROSSNAGEL

Safety Engineer

Consolidated Edison Co. of New York, Inc.

SEVEN YEARS AGO the Consolidated Edison Co. embarked upon a simple program of fire extinguishment training, which since has developed into the well-known "Con. Edison Fire School".

In line with the company policy of giving all its employees training to make them more proficient in their regular jobs, it was decided to include training in fire fighting for any employee unexpectedly may be called upon to take part in extinguishing a major fire in company property before it gets out of control.

In the gas plants, fire brigades have been organized on each watch. These brigades are made up of men not "tied down" to fixed posts. In the electric stations, however, the men work on rotating shifts and they rotate on different days of the week. This would make it very difficult to maintain the same number of men on the brigade on all watches of each day of the week. Hence, in the power plants, jobs instead of men are assigned to the fire brigades. For instance, a brigade might be made up of the watch engineer (fire chief), pump room oiler, pipe fitter foreman, janitor, machinist and a switch galleryman. Then, whoever is on duty in these jobs at the time of the fire is automatically on the fire brigade. On the other hand, although not organized into brigades, most of the employees in storehouses, garages and other commercial buildings are given training.

Training follows a well-planned schedule, and is divided into two 3-hour classes and one 1-hour class. It should be understood thoroughly that we cannot make an expert fire fighter in three short lessons, but in an emergency, a man with seven hours' training is a lot more valuable than one with no formal training.

Consolidated Edison's Astoria, Long Island, plant occupies about 300 acres within the city limits of New York. Originally it contained only the gas manufacturing plant, but recently the North Queens Sub-Station was built on this property, and at the present time the new Astoria Generating Station is under construction there.

In an isolated part at the plant, about ¼ mile from the nearest houses, a one-acre fenced-in area was set aside as a drill field for the Fire School. Fig. 1 shows a plan of the area, about 125 by 350 ft. "Props" have been set up to simulate nearly every type of fire which can be imagined as occurring in any of the Edison gas, electric or steam plants or distribution properties. Figures 2 and 3 show company men extinguishing these "staged" fires with equipment available to them within the plants.

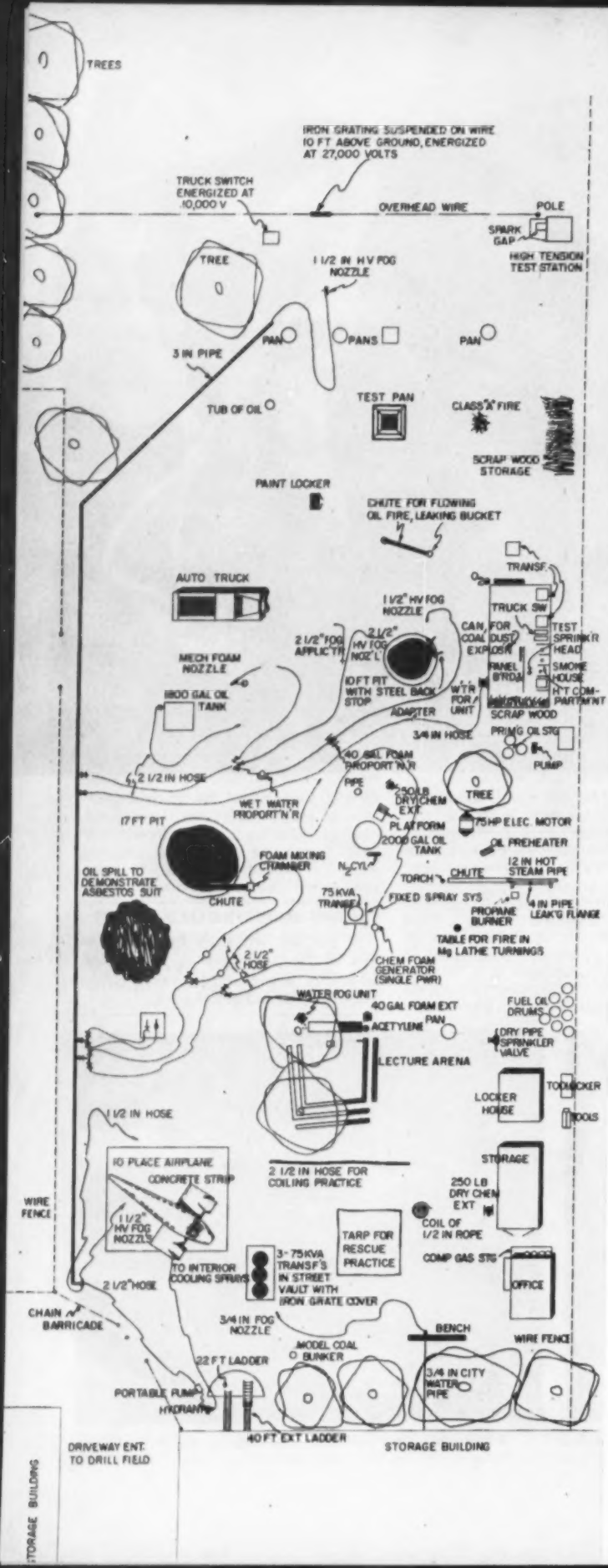


Fig. 1. Extinguishing gear and facilities for simulating industrial fires are packed into this acre of fenced-off Fire School grounds

Fire Fighting to Power Engineers

The Astoria and Hunts Point gas plants are located close to the airport, and nearly in line with one of the runways, and their acres of open fields might prove very inviting to a pilot of a departing passenger plane which is having difficulty in gaining altitude. Hence, the fire brigades of these plants, each of which is outfitted with a fully equipped 500-gpm pumper truck, are given special training in doing all that is practicable for them to do in rescuing crash victims.

During the four months that the school operates each year, extinguisher classes are held every Tuesday morning from 9:00 to 12:00, and heavy duty classes on Thursday at the same hours. The men are required to attend any Tuesday class and any Thursday class that is most convenient for them. Schedules of the Tuesday and Thursday classes are given on the following pages.

Every man is expected to take an active part in both classes. This means using extinguishers, handling hose, performing rescues, and similar duties, at least four times at each class, as well as closely observing the work of the other students. Those "graduating" from the training program are given recognition cards which they call diplomas.

During the winter months a "post-graduate" class is held in the various company auditoriums on the "Elements of Combustion". This is a demonstration lecture on the theory of fire. This program includes demonstrations of flash point, ignition temperature, explosive limits, vapor density, and vapor pressure, as well as small scale vapor-air explosions, dust explosions, and so on.

Classes average 30 to 40 men each. To date nearly 6,000 company men have received the training, but this includes many repeaters year after year. During the 1952 season Consolidated Edison met the request of the United States Coast Guard to give the training in special classes to about 1,150 port security officers and men. Among the officers were two rear admirals, four captains, five commanders, 16 lieutenant commanders, and many ensigns and petty officers.

In addition to Consolidated Edison and Coast Guard men, training has been given to men from 20 public utility companies, many other industrial companies and United States Government agencies, firemen from 19 municipal fire departments, and men from India and Liberia. The drillmaster has been called upon to give training lectures before fire departments and firemen's associations in more than 20 cities and towns, usually illustrating his discussion with colored movies of the "Con. Edison Fire School".

Fig. 2. A high velocity water fog nozzle is used in smothering this fire without spreading the burning oil

Schedule 1. Program for Tuesday classes of the "Con. Edison Fire School".

1. Lecture on the various types of hand-portable extinguishers.

2. Fire in scrap packing cases, etc., using soda-acid and antifreeze extinguishers.

3. Fire in small tub of oil, using 1 qt vaporizing liquid, 2½ lb CO_2, 4 lb dry chemical, and 2½ gal foam extinguishers.

4. Fire in engine space of auto truck, using 1 qt vaporizing liquid, 2½ lb CO_2 and 4 lb dry chemical extinguishers.

5. Paint locker fire. Gasoline is pumped into top of locker and flows down over cans on shelves below. Fifteen lb CO_2 usually is ineffective, but 20 lb dry chemical readily handles it.

6. Flowing oil fire. Gasoline flows from holes in bottom of a 12-qt pail onto upper end of long sloping chute. Extinguished by 15 lb CO_2 and dry chemical.

7. Fire in a 10-ft-diameter pit of fuel oil, primed by gasoline. Rookie readily extinguishes this fire with one 20-lb dry chemical extinguisher.

8. A 15 by 30 ft building contains simulated high tension electrical compartments located behind a partition to make matters more difficult. Transil oil is piped into top of one of the compartments and flows down onto the floor. The flames reach the ceiling. This fire is then first extinguished by means of a custom-made wheeled 20-gal water-fog extinguisher designed by Consolidated Edison, then by a 15-lb CO_2 extinguisher.

9. To give the students a chance to sit down and rest, they return to the lecture arena where they receive a refresher talk on gas masks.

10. Another fire is started in the "smoke house", and this time two students (with the instructor) equipped with all-service type gas masks put out the fire with 1-gal pressurized vaporizing liquid extinguishers.

11. A fire in a 75-hp electric motor is extinguished easily with a 1-qt vaporizing liquid extinguisher.

12. Liquid propane under 125 psi pressure escapes from a defective gasket in a 4-in. flanged pipe, and burns with an intense flame. The students are taught never to extinguish a gas fire unless doing so enables them to reach a shut-off valve and such a valve is close to the flame. A 15-lb CO_2 extinguisher is ineffective, but the fire is almost instantaneously put out with one "shot" from a 20-lb dry chemical extinguisher and the valve then closed.

13. A quart measure full of magnesium lathe turnings is ignited. Water makes them burn more vigorously. Carbontetrachloride makes an explosion. Dry sand covers and controls the fire, but usually does not extinguish it. Special powders usually extinguish the fire without difficulty, unless the chips are wet.

14. Transil oil leaks from the radiator fins of a 75-kva transformer and burns vigorously. Fifteen-lb CO_2 and 20-lb dry chemical extinguishers both prove effective.

15. An old panel box, "wired" with electric wiring having combustible insulation, is ignited. Vaporizing liquid, CO_2, dry chemical, and water fog (from the portable unit) are used successively.

16. Gasoline from leaking underground storage tanks in service stations frequently gets into concrete electric service boxes in the city streets, becomes ignited and throws the cast iron cover up into the air. An attempt is made to duplicate this condition at the Fire School.

17. A large concrete transformer vault containing three 73-kva oil-cooled transformers is flooded with transil oil and ignited. The street pavement grating is removed and the fire extinguished by two 15-lb CO_2 extinguishers used simultaneously. Dry chemical is much more effective but the powder drifts with the wind and deposits on all the newly polished cars parked in the neighborhood. This does not promote good public relations for a public utility company, so it is customary to attempt to extinguish the fire first with CO_2.

18. A tarpaulin is spread on the ground and the men are given practice in rescue operations, including the "fireman's carry" and the removal of an unconscious man from a manhole by means of a rope.

19. Practice is had in carrying and raising a 22-ft single ladder and a 40-ft extension ladder. The firemen's "leg lock" on a ladder is demonstrated.

Fig. 3. "Visiting firemen" watch a trainee stop a flowing gasoline fire with a handy CO_2 extinguisher. Trainees use extinguishing apparatus which is available in the plant and become thoroughly familiar with its operation. Note paint locker and truck for other demonstrations in background

Schedule 2. Program for Thursday classes of the "Con. Edison Fire School".

20. Lecture on the use of fog nozzles, chemical and mechanical foam, hose and fire hydrants.

21. A 10-ft-diameter pit of fuel oil primed with gasoline is set on fire. (A 17-ft pit is available, but because of municipal smoke regulations, it seldom is used.) Extinguished from the windward side by means of 1½-in. high velocity fog nozzle. If the wind is not too strong, this also is repeated from the lee side using two hose lines.

22. Same fire, using wet water fog.

23. Same fire, using the 2½-in. low velocity fog applicator handled by four men.

24. Same fire, using mechanical foam from 1½-in. hose.

25. Same fire, using chemical single-powder foam from 2½-in. hose.

26. Rectangular tank containing 1,800 gal of fuel oil is set on fire. Extinguished by four men using the 2½-in. low velocity fog applicator.

27. Same tank fire, using fog-foam.

28. Oil (but no fire) in 17-ft pit. Two-powder fixed foam system demonstrated.

29. Emergency repair to defective hose, using hose clamp, Cooper hose jacket, and slipping end of hose inside other hose.

30. Demonstration of "cellar pipe" under simulated loading platform.

31. Lecture on the use of special apparatus, such as the safety can, combustible gas indicator, piezometer, pressure reducer, hose thread adaptors, industrial fire alarm system, hazard of electric shock when standing in puddle of water, etc.

32. Fire in transformer vault (see 17), using 2½-in. high velocity fog nozzle delivering through grating.

33. Demonstration of "deluge set" with 2½-in. fog nozzle.

34. Fire in 75-kva transformer. Extinguished by fixed spray system.

35. Simulating a condition existing in nearly every power plant, oil is allowed to leak onto a hot steam pipe (heated by propane burner at the Fire School) where it ignites spontaneously.

36. About 3 qt of pulverized coal is spilled from the ceiling inside the smoke house, forming a dust cloud which is ignited by a small flame at the floor level. A big puff of flame follows.

37. Propane fire (see 12). Men with 1½-in. fog nozzle drive flame back so as to gain access to shut-off valves.

38. A round tank containing 2,000 gal of fuel oil is ignited. Extinguished by air agitation method, air or nitrogen being injected into the lower portion of the tank.

39. Fire in transil oil spilled under a truck switch energized at 10,000 volts. Extinguished by means of the 20-gal water-fog unit.

40. A steel grating is suspended from an overhead wire mounted on pole insulators and energized to 27,000 volts by means of a high potential test set. The men hold the brass high-velocity fog nozzle in their bare hands, while standing on wet ground 8 ft away, and direct the fog of salt (sea) water onto the target. A milliammeter records any current flow through the men's bodies.

41. The correct (doughnut roll) and the incorrect methods of coiling up fire hose are demonstrated.

42. A fire of 25 gal of gasoline spilled under a 2-motor 10-passenger airplane (a big difference from a possible 5,000 gal spillage) is driven away from the escape door to enable the men to get to the airplane and rescue a dummy. The fire is extinguished later at their convenience. The practice is on rescue rather than extinguishment.

43. Inasmuch as asbestos suits are installed in company plants, a 10-ft-diameter shallow spillage of fuel oil is ignited and a man wearing the protection walks through the flames and back again.

44. The asbestos suit is demonstrated in closing the shut-off valve close to the intense propane flame (see 12).

45. Any remaining time is spent on a very brief lecture on the elements of combustion.

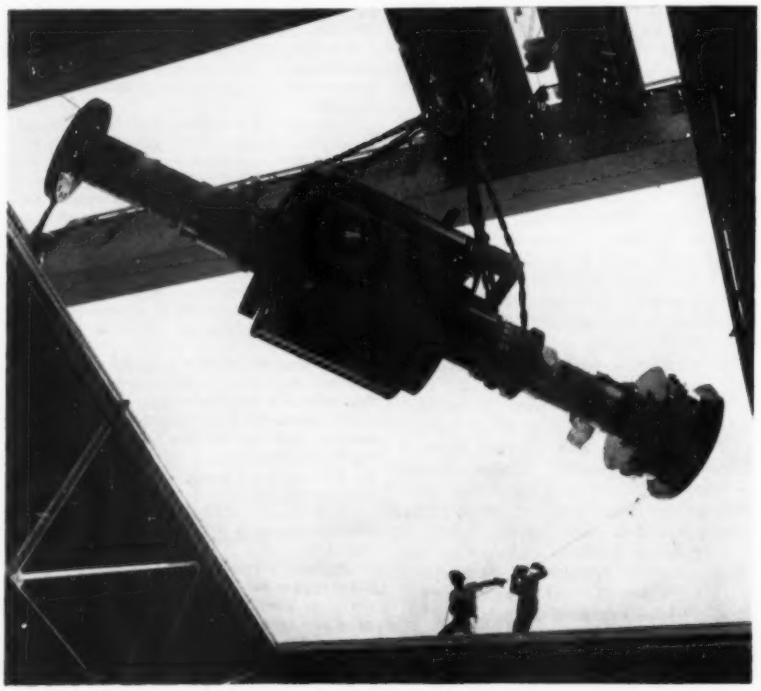
The Largest Motor in the World

THE MOST POWERFUL electric motor ever built — 83,000 horsepower — has been installed at the Arnold Engineering Development Center, Tullahoma, Tenn. It is the first major step in assembly of the 216,000-hp electric drive for the new transonic and supersonic wind tunnels for the United States Air Force.

The giant synchronous motor is one of two such units built by the Westinghouse Electric Corp. at East Pittsburgh, Pa. The second unit will be installed in the near future, along with two 25,000-hp induction motors.

Still under construction are the compressors these motors will drive. The compressors, also the largest ever built, will have blades 2 ft wide and 6 ft long mounted on a spindle 18 ft in diameter. Each blade weighs almost ⅔ ton, and will rotate at a speed of 600 rpm.

When the motors and compressors are assembled completely, they will comprise the world's largest rotating machine. Previously, the world's largest were rated at 65,000 hp.



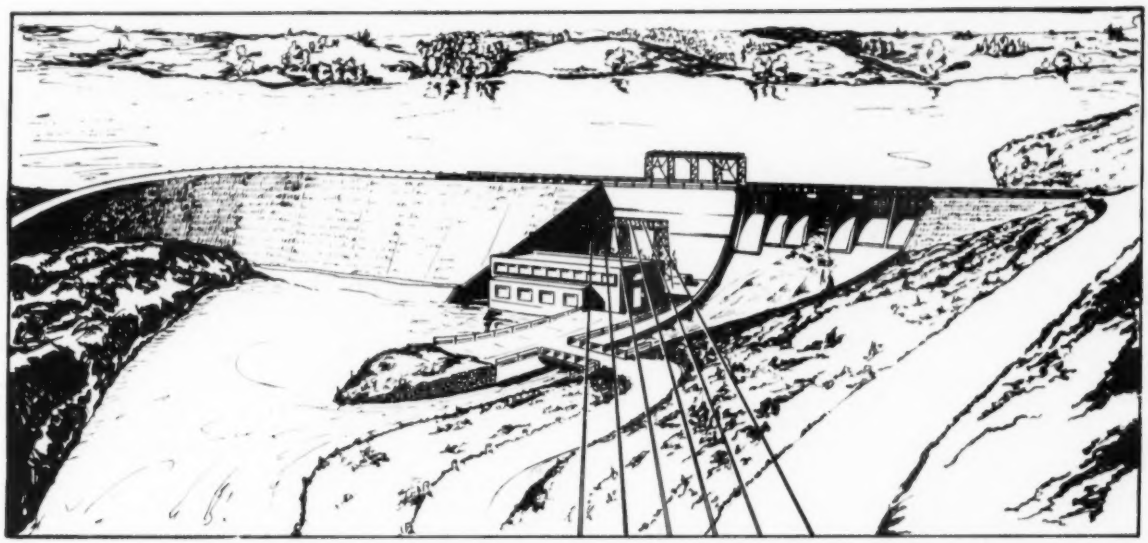


Fig. 1. Artist's concept of Littleton Development in New Hampshire on Connecticut River. Besides power, it will provide recreational area around reservoir

Littleton Will Complete 15-Mile Falls Development

FIVE MILES northwest of Littleton, N. H. and eight miles southeast of St. Johnsbury, Vt., Connecticut River Power Co. is building a major hydroelectric power plant on the Connecticut River to be known as the Littleton Development. When placed in operation late in 1956, this 150,000-kw plant will complete the harnessing of that stretch of the river known as Fifteen Mile Falls.

Connecticut River Power Co., a subsidiary of New England Electric System, now operates two other hydro plants in this general area, as shown in Fig. 2. These are the Comerford Station, which was completed in 1930, and McIndoes Station, completed in 1931. Including Littleton, these plants will have a total capacity of 310,000 kw using a total river fall of 367 ft.

Site of this newest power development is steeped in history, dating back to Rogers' Rangers. After 1900, various attempts were made to find economical means of using the undeveloped fall for local industrial and utility uses. However, it was not until the formation of the New England Electric System and the purchase by its subsidiaries of the water power lands and rights in 1926 that a solution was found. By connecting these water powers with a large integrated electric system, a market could be reached for the absorption of the variable output from these large-scale plants, and in addition this same transmission network would provide means for importing steam power when the Connecticut River flows were too low to meet needs.

The rapid growth of power requirements in New England during and since World War II has resulted in a need for the peak power that will be generated by Littleton.

The Development, Fig. 1, will consist of a dam, reservoir, power house and allied transmission facilities. The reservoir will be the largest on the main stream of the Connecticut River with a total length of 11 miles and an area of 3500 acres.

The powerhouse will be built on a ledge downstream from the dam, to which it will be connected by 300-ft penstocks. It will house four identical vertical-shaft hydraulic turbines, each directly connected to its generator.

Electric power generated at 13,800 v will be carried to an outdoor substation where it will be stepped up to 230,000 v for transmission to Comerford Station, seven miles to the south. Through this high tension line, the Littleton Development will be tied into the interconnected transmission network of New England Electric System. Electricity will be transmitted locally at 34,500 volts, and to the Green Mountain Power Corp., Public Service Co. of New Hampshire and Central Vermont Public Service Corp. Cost of the Littleton Development will be about $50,000,000.

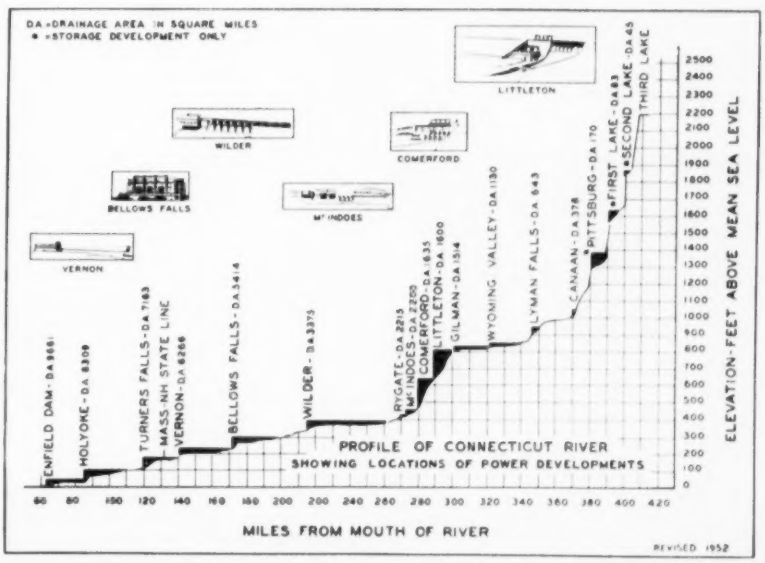


Fig. 2. Profile of Connecticut River, showing location of power plants of New England Electric System

Cooling tower foundations and storage basins usually are elaborate and expensive. This article describes a new design that is cheaper to construct and easier to maintain than the usual type

Keep Down Cooling Tower Costs

By

E. H. KRIEG and **W. L. CHADWICK**

Consulting Engineer — Vice-President

Stone & Webster Engineering Corp. — Southern California Edison Co.

ALMOST EVERY ENGINEER is well aware of the importance of selecting the best size of cooling tower by evaluating the most economic combination of cooling tower cost, fan power, turbine vacuum and other factors. But further economies are possible in investment cost and maintenance as well as in improving availability. Here are some of the ways to attain them:

A major element of investment cost — the foundation and storage basin — has sometimes been a bit neglected. It long has been a common practice to build a rather elaborate combination foundation and water storage basin under cooling towers. These have been expensive because concrete posts usually are required on about 6-ft centers to support the cooling tower columns. In addition, cleaning costs of such deep basins are high, especially in dusty areas where the large quantities of air passed through the cooling tower bring in great amounts of dust, insects, leaves and other debris, to be washed down into the basin.

Novel Foundation Design

When it came to designing the cooling tower foundations for the Etiwanda Steam Station of the Southern California Edison Co., a new design approach was made. Among the principal criteria of design were: Economy in first cost and maintenance, and availability.

How could a cooling tower foundation be simpler than a flat concrete slab laid on the ground without any formwork either for basin side walls or pedestals for the cooling tower interior columns? As will be seen in Figs. 1 and 2, simplicity of design and construction has been obtained, and with it, low first cost. Even cheaper designs such as "blacktop" and a 2-in. gunited slab were considered, but neither could support the tower weight, and footings with either slab proved more costly than the concrete slab which distributes the column loads over the ground surface.

Open Canal for Water Supply

The usual deep cooling tower basin was provided not only to store the cooled water but also to convey it toward the circulating water pumps. If such a basin is to be eliminated, the requirements of storage and conveyance still must be met, and, in Southern California, what could be more economical than a gunited excavation? So, along one side of the four cooling towers which will supply 140,000 gpm to two 125,000 kw turbine generators, an open canal lined with gunite not only will collect and convey water from the four towers to the central sand settling basin and circulating pumps, but also will act as a 150,000-gal storage basin from which to control the water level in the entire circulating water system. Experience with gunited flumes in California has been particularly good and is, in many places, the most economical means of transporting or storing large quantities of water when loss to the ground must be avoided.

Tower Construction

In Figs. 2 and 3 will be seen the four flat slabs for the cooling towers and the entire 850-ft length of the gunited flume which leads to the sand collecting basin observed at the nearest cooling tower slab.

Economic studies were made to determine best tower size based upon overall costs of several water approach temperatures, together with variable vacua. Weather data for the station vicinity showed that an average wet bulb temperature of 58 F could be expected. Calculations for tower sizes based on 12 F, 15 F, and 18 F approach temperatures and related vacua and expected plant load factors indicated that a tower sized to maintain a 15 F approach would be the economical choice, but to provide a somewhat higher level of performance and economy a final figure of 14 F was selected.

A review of the grades of redwood specified indicated that a substantial saving could be made by matching the grade of lumber more closely to

Fig. 1. View of the four cooling tower base slabs

Fig. 2. Finish grading of cooling tower flume. At left can be seen completed cooling tower base slabs

the service. Accordingly, "Clear All Heart" is used for the outer end casing and certain other exposed portions of the tower, "Select Heart" for the inner end casing and various structural members, and "Construction Heart" for unfabricated cooling tower filling strips.

Seldom is it realized what large quantities of dust, sand, leaves, insects and other debris will be brought into towers by the induced draft fans.

The Etiwanda towers require 16,640,000 cfm of air. This 4,000 cu ft of air for each kilowatthour represents a 255-ft cube of air per minute for a 250-mw plant load. A debris loading of only 1 ppm would mean the annual collection of 630,000 lb of debris. The necessity of preparing to collect and remove it at one central point is obvious.

To clean the basin under the usual cooling tower, it is necessary to remove cells from service. It is expected that the foundation slab will be self-cleaning, but if supplemental hosing down is found essential, this can be done by one man and without removing any cell from operation.

Removing Debris

Instead of such debris collecting into a deep basin with pedestals from which removal would be costly, it will be possible to hose down the flat slab under each tower, flushing the debris into the flume where the water velocity of 5 fps should carry much of it to the sand settling basin where the velocity is reduced to 1. fps and appropriate baffles provided. This provides a central and economical means of removing by a grab bucket whatever debris is carried into the tower.

The cooling tower make-up problem is accentuated by the necessity of using Colorado River water having about 700 ppm of dissolved solids. Also, this is expensive water, as it must be raised by pumps a total of 1,618 ft and transported more than 250 miles from Parker Dam across the intervening desert before reaching the plant.

A treatment plant will stabilize the cooling tower make-up water, relatively high in dissolved solids, to allow higher concentration and hence minimize blowdown. This will be accomplished by maintaining a suitable Langelier saturation index to avoid deposition of scale on condenser, hydrogen, and oil cooler tubes, on one hand, and avoid the corrosion caused by excessive acidity on the other.

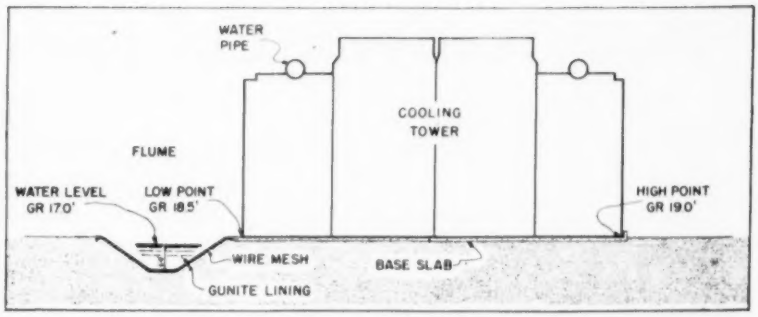


Fig. 3. Outline of tower, base slab and open canal for collecting the water from four cooling towers

Special attention is being given to means of handling fan parts during maintenance and overhaul to keep down the size of maintenance crews. A 1-ton gantry crane made from piping and built to travel along the tower top will lift and transport motors, gear boxes, or fan blades to one end of each tower section where they may be lowered to the ground through a trap door.

Cooling Water Make-up

To provide cooling water make-up for a day or two should the aqueduct water supply be interrupted, a 40 acre-ft (13,000,000 gal) storage basin shown in Fig. 4 was built on the site. This basin is formed of rolled earth-fill dikes constructed by modern earth-dam techniques. A gunite lining is provided to avoid loss of water and the risk of damage to the basin by rodents and erosion.

The possibility of exploiting the favorable wind condition as much as possible by the best tower orientation was investigated, i.e., parallel or normal to the prevailing wind. However, little data is available on the isotherms to be expected on the lee side of cooling towers in any particular position, or on recirculation as affected by tower orientation. Other major considerations were avoiding recirculating vapor to future towers and minimizing drip or fog effect on plant working areas. These studies led to positioning four 145-ft-long sections of tower nearly normal to the prevailing wind direction with 85 ft between sections. This layout should give best performance for the 835-ft length.

As well as treating the make-up water it is necessary to dispose of the blowdown without harming the underground water in the deep alluvium upon which the plant is erected. Various schemes were considered, but none offered an assured means of disposal except the construction of 14 miles of precast bell and spigot concrete pipe, 18 to 24 in. diam from the plant site to a connection with disposal facilities leading to the sea. Cooling tower blowdown water thus will be transported more than 60 miles to final disposal at sea.

Conclusion

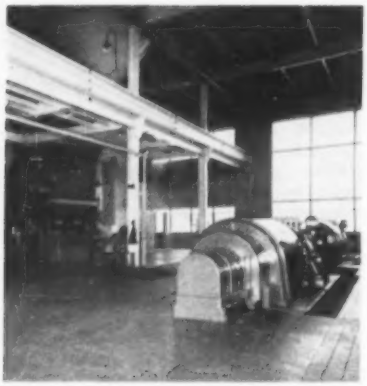
To sum up then: simple concrete slabs instead of complicated basins, and open gunited flumes to carry the water to and from the towers give economy in first cost and maintenance, and greater availability.

The authors are indebted to T. Hotchkiss, of Southern California Edison Co. for his assistance.

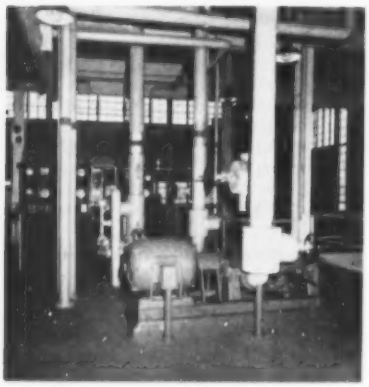
Fig. 4. Gunite lining the water storage reservoir that will provide cooling water make-up for a day or two if the normal aqueduct supply should be interrupted

New Turbines Cut Kwh Costs 26%

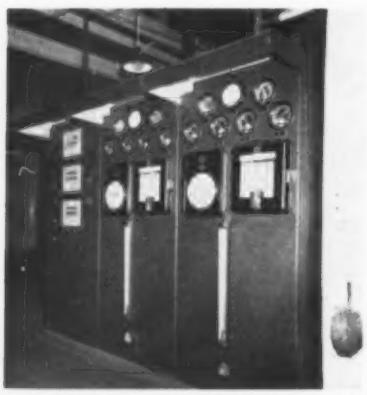
A municipal government was generating its own power for 13.11 mils per kwh, purchasing power for 11.15 mils per kwh. Changing from diesels to turbines reduced cost to 8.98 mils.



Interior view of Menasha, Wisconsin, power plant showing the two 4000-kw turbine generators and one of the two boilers with stokers (left rear)



Boiler feed pump in foreground has 200-gpm capacity at 1700 ft head, is motor-driven. Spare pump in rear is driven by a small steam turbine



Both turbines are controlled from these well-lit panels. Duster (right foreground) is one of many located throughout the plant as housekeeping aids

MENASHA, WISC., after nearly 45 years of operating its municipal facilities on diesel-generated power supplemented by purchased power, has switched over to turbine generators and coal-fired boilers. The new installation, on which construction was begun in July, 1948, now has completed more than a year's operation that proved the wisdom of the change.

During 1952, the first full year's operation, two new 4000-kw turbine generators produced 24,813,600 kwh for $223,042.37. The diesels, which were retained and run part-time, generated 155,700 kwh for $3,491.79. Total generated power was 24,969,300 kwh for $226,534.16 in 1952 as compared with 19,812,816 kwh, generated by diesel and purchased, for $240,772.67 in 1948. Cost details are given in Table I.

In 1905 the city's total power requirements were represented by 80 arc lights for street lighting. At that time the municipal plant consisted of three 75-hp diesels; two of these drove triplex pumps for the municipal water system while the third drove a 60-kw generator. By 1930 the plant contained two 600-hp and two 1200-hp diesels, the water pumps being driven by electric motors, and the load curve was rising steadily. In 1938, total power production reached 9,166,890 kwh and more power was needed to handle the peaks. The Wisconsin-Michigan Power Co. contracted to supply peak power while the municipal plant continued to handle the base load. Three 1000-kw, 33,000-volt transformers were installed to join the two systems.

Consultants Hired

During the next eight years, the expanding city increased its load requirements to 16,360,388 kwh — almost twice the 1938 total. At this point the Water and Light Commission hired consulting engineers to study local load conditions and make recommendations for the most practical and economic steps to take.

Peak loads rapidly were approaching the 4000-kw mark at this time and showed no signs of slowing down. The consulting engineers, considering this and the high cost of existing generating and procurement practices, recommended the construction of a coal-fired steam generation plant of sufficient size to handle the entire load. Their recommendations were adopted and construction was begun in July of 1948.

The first 4000-kw turbine generator was put on the line in November of 1949, by which time peak loads already had exceeded 4000-kw. A new peak of 4790 kw was reached on the 28th of that same month. The second unit, identical to the first, was put in operation early in 1950.

The New Plant

Plant facilities now are housed in an attractive light-colored brick building which is designed to accommodate future expansion. Steam is generated in two 60,000 lb per hr, 3-drum, bent-tube, boilers at 625 psi. Steam emerges from the superheater at 750 F. Boiler efficiency is held at the maximum by parallel control of draft and fuel feed (speed control of the spreader stokers) in accordance with steam consumption; this, in turn, is indicated by steam pressure. Induced draft is regulated automatically to maintain proper furnace draft, but manual adjustment of the forced draft is required to restore the desired fuel-air ratio after a change.

Coal is shipped to the plant by rail and dumped from hopper-bottom cars into a track hopper. Coal is carried from the track hopper by conveyor belt either to the boiler bunkers or to the outdoor storage pile. Bunker coal drops by gravity onto the coal scales and then to the stokers. Spontaneous combustion of coal in the outdoor storage is inhibited by compacting with a bulldozer, which is used in handling the coal.

Both turbines are condensing-extraction type units. Throttle pressure is 600 psi at 750 F, and the turbines exhaust to a 4000-sq-ft, 2-pass condenser at 28 in. Hg vacuum. Each generator is rated at 5000 kva and operates at 4160 volts.

Condenser cooling water is taken from the nearby Fox River and circulated by a 50-hp, 4000-gpm centrifugal pump. An additional 2500-gpm motor-driven pump and a steam-turbine-driven 1500-gpm pump are available for light load conditions.

Four stages of feedwater heating are employed, the second stage being a deaerating heater while the first, third and fourth stages heaters are the closed-shell-and-tube type.

Operating economies effected with the new plant are revealed by a

comparison between the years 1948 and 1952 — respectively, the last full year of operation in diesel-generated and purchased power and the last full year of operation with the new steam plant. In 1948, the diesel plant produced a net of 10,099,566 kwh at a cost of $132,422.51. In addition, 9,713,250 kwh were purchased for $108,350.16. Costs for generated and purchased power, respectively, were 13.11 mils and 11.15 mils per kwh, with the average for the total being 19,812,816 kwh for $240,772.67, or 12.13 mils per kwh.

By contrast, the 1952 totals were 24,969,300 kwh (of which only 155,700 kwh was diesel-generated) for $226,533.16. Diesel-generated power cost 22.42 mils per kwh while the steam-generated power came to 8.98 mils per kwh. The average cost per kwh was 9.07 mils. This amounted to a 6 per cent reduction in annual production costs, a 26 per cent increase in production and a 26 per cent reduction in kwh costs. See Table I for a detailed comparison of costs.

The small total of 155,700 kwh was generated by the diesels merely to "exercise" them and assure their availability for emergency use.

Local Rates Low

At $3\frac{1}{2}$ cents per kwh for the first 1000 kwh used, the city's residential electric rate is among the lowest in the state. The water heating rate is a flat $1\frac{1}{4}$ cents per kwh. Even with these rates, low production and distribution costs spelled a profit (before depreciation) of 7.1 mils per kwh in 1952 — or more than $175,000.

Both residential and industrial in nature, the city's population now has reached 12,000 persons. Anticipating further increases in both domestic and commercial demand, the plant was designed with an eye to increased generating capacity. Growth statistics indicate that this is wise and may be necessary quite soon. During the last 10 years, total load has doubled. Between 1949 and 1950 alone, the total load increase amounted to more than 2,000,000 kwh. Menasha can be sure that electric power supply, a major problem in all expanding cities, will not inhibit the vigorous growth indicated by this load jump.

TABLE I. REVENUES AND EXPENSES FOR YEARS ENDING 12-31-48 (DIESEL) AND 12-31-52 (STEAM), MENASHA, WISCONSIN, MUNICIPAL POWER PLANT

PRODUCTION EXPENSES—DIESEL	
Operation, Supervision and Engineering	$ 3,837.30
Engine Labor	13,830.44
Electric Labor	81.54
Misc. Station Labor	1,674.59
Engine Fuel	98,622.64
Cooling Water	28.08
Lubricants	1,646.69
Station Supplies	1,928.89
Station Expenses	526.38
Maintenance—Structures and Improvements	162.41
" —Fuel Holders	109.82
" —Engine No. 1	3,650.77
" —Engine No. 2	5,414.70
" —Engine No. 3	766.73
" —Generators	3.49
" —Accessory Electric Equipment	58.41
" —Misc. Power Plant	79.63
Total Production Expenses (Diesel)	$132,422.51
Purchased Power	108,350.16
TOTAL	$240,772.67

	KWH	MILS KWH
Net Generation	10,099,566	13.11
Purchased Power	9,713,250	11.15
Total	19,812,816	
Average Cost		12.13

PRODUCTION EXPENSES—STEAM	
Operation, Supervision and Engineering	$ 5,500.00
Boiler Labor	17,914.78
Prime Mover and Generator Labor	16,790.98
Misc. Station Labor	6,761.91
Fuel	160,043.53
Water	996.94
Lubricants	125.11
Station Supplies	2,346.82
Station Expenses	1,602.85
Maintenance—Supervision and Engineering	4,824.40
" —Structures and Improvements	96.00
" —Coal Storage and Handling Eqt.	1,972.15
" —Furnace and Boiler No. 1	459.39
" —Furnace and Boiler No. 2	276.05
" —Boiler Apparatus	1,901.21
" —Steam Piping and Accessories	854.03
" —Prime Mover & Generator No. 1	90.93
" —Prime Mover & Generator No. 2	53.73
" —Misc. Power Plant Equipment	414.76
" —Accessory Electric Equipment	16.80
Total Production Expenses (Steam)	$223,042.37
Total Production Expenses (Diesel)	3,491.79
TOTAL	$226,534.16

	KWH	MILS/KWH
Net Generation (Steam)	24,813,600	8.98
Net Generation (Diesel)	155,700	22.42
Total	24,969,300	
Average Cost		9.07

LIST OF PRINCIPAL EQUIPMENT AT MENASHA, WISCONSIN, MUNICIPAL STEAM POWER PLANT

Turbines	(2) 4000 kw, 600 lb, 750 deg F, 3600 rpm, extraction-type turbine. Worthington
Generators	(2) 5000 kva, 4160 volt, 3600 rpm, 3 ph, 60 cycle, synchronous generator. Worthington Corp.
Condenser	(2) 4000 sq ft, 2-pass surface condenser. Elliott Co.
Boilers	(2) 3-drum, bent tube, stoker-fired, 60,000 lb per hour at 625 psig—750 deg F at superheater outlet. Wickes Boiler Co.
Boiler Controls	Bailey
Circulating pumps	(3) 4000, 2500, and 1500 gpm respectively at 35 ft TDH. Centrifugal motor-driven except 1500 gpm turbine-driven. Allis Chalmers.
Air Cooler	(2) 10,000 cfm. Schutte & Koerting.
Air Ejectors	(2) 2-stage. Elliott Co.
Condensate pump	2-stage, 60 gpm, 90 ft TDH. 1150 rpm, centrifugal. Elliott Co.
Air Compressors	(1) 8 in. by 9 in., capacity 117 cfm. Worthington Corp.
Boiler Feed Pumps	(1) Triplex variable stroke, capacity 125 gpm, 725 psig. Worthington Corp. (1) 2½ in. volute pump, 150 gpm at 725 psig. Worthington Corp. (1) 2½ in. centrifugal pump, 200 gpm. at 725 psig. Worthington Corp.
Evaporator	Lummus Co.
Closed Feedwater Heaters	Whitlock
Condensate Tank	Graver Tank & Mfg. Co.
Main Switchgear	Westinghouse
Auxiliary Switchgear	I.T.E. Circuit Breaker Co.

Clean Your Condensers Chemically

Chemical cleaning of surface condensers is faster than other methods; scale removal is more complete; tubes don't get damaged; and both steam and water sides can be cleaned. This is how the job is done

By JOHN H. RUSCH

Dowell Incorporated

CONDENSER tubes in steam turbine surface condensers must be kept clean for two main reasons. First, deposits on the tubes lower their heat transfer rate; this increases the condenser back pressure, which in turn reduces the thermal efficiency of the turbine. Second reason is to prevent tube pitting or impingement corrosion. Pitting is the main cause of deterioration of brass tubes. It is caused by foreign matter attached to the surface of the tube, actually beneath an adhering deposit. Impingement corrosion is caused by entrained gases and occurs on the small areas of metal exposed by breaks in the oxide of hydroxide coatings on the tubes. If this coating were present as a continuous film, the impingement corrosion probably would be minor.

Complete removal of these deposits gives a clean surface with few places for corrosion products to form pits. Any subsequent attack by oxygen or an acidic condition in the water would result in an even dissolving action with only minor penetration at any one point.

Mechanical means first were devised for cleaning condensers and some of these methods still are employed. Pneumatically driven rubber plugs, rods with rubber or metal plungers, and pneumatically driven turbine brushes or cutter heads still are used for tube cleaning. However, with the rubber plugs, deposits held tenaciously to the tubes cannot be dislodged. The cutter head tools require care in operation to avoid damaging the tube metal. On the whole, these methods are time consuming and only partially effective since much of the foreign matter remains behind in the pits and irregularities of the tubes. This remaining deposit then can act as a nucleus for additional corrosion products to form.

Chlorination of the circulating water is used by many companies and should be included in discussions of condenser cleanliness factors. Use of chlorination has been very effective where algae and marine growths are taking part in the build-up of fouling deposits.

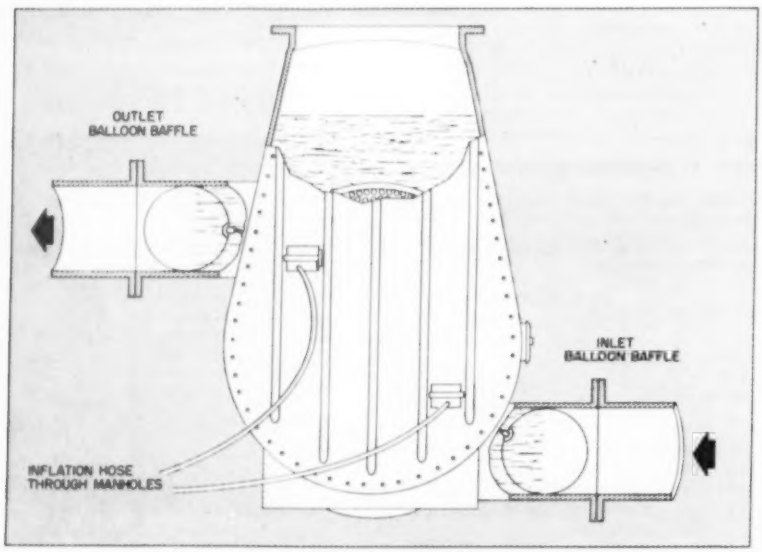


Fig. 1. Rubber-covered nylon pressure bags in use as baffles during the condenser cleaning operations

Advantages of Chemical Cleaning

Chemical cleaning has the following advantages over mechanical methods:

1. Faster Cleaning. The average treatment time for larger turbine-condensers has been from 6–12 hours. This is dependent upon whether or not both sides are cleaned, and upon the sizes of filling and draining facilities.

2. Removal is more complete. Since a liquid solvent is employed, corrosion products and deposits can be removed, not only from tube sheets and water boxes, but from pits and irregular portions of the tubes as well.

3. Better metal protection. Excessive metal losses or cut tubes, often experienced with mechanical cleaning, are eliminated. Control of temperatures, time, solvent concentration and the use of effective inhibitors reduce metal loss during chemical cleaning to a negligible figure. The corrosion rates of the various metals normally encountered in condensers are shown in the accompanying Table I.

4. Steam side can be cleaned. The outside of the tubes cannot be cleaned by mechanical means. Although the amount of deposit on the steam side is small, it is often chemically cleaned along with the water side. These deposits usually consist of a thin layer of copper oxide formed by the action of entrained air and are removed effectively by a relatively low solvent concentration.

Details of methods used in chemical cleaning of steam turbine condensers, as given below, were presented by the author recently before the Southeastern Electric Exchange.

Effective removal of these condenser deposits depends on advance knowledge of the nature of the scale. The most satisfactory samples for condenser cleaning have been sections

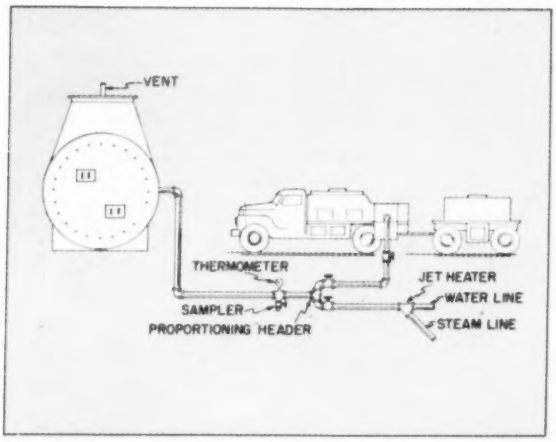


Fig. 2. Typical hook-up for cleaning condensers by use of chemical solvents

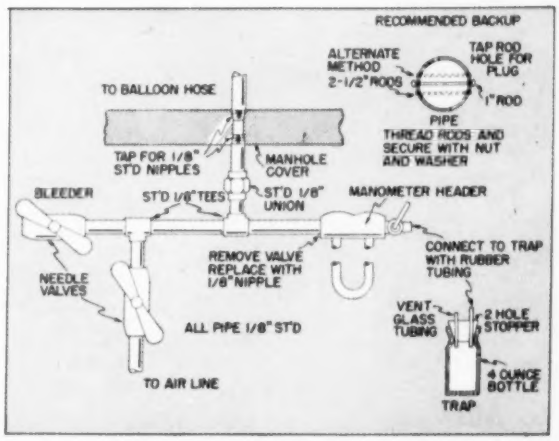


Fig. 3. Valve and manometer connections for controlling the balloon baffles

of tubes removed from the unit to be cleaned. A large steamship company, with a program for periodically cleaning the main condenser on each of its ships, has been removing four representative tubes from each condenser. With such samples, it is possible to determine accurately the degree of previous tube deterioration or pitting, the present metal condition, and the deposit thickness and density. Various solvents at several temperatures then can be tested for their cleaning effectiveness on the actual intact scale. When actual tube samples cannot be obtained, a complete analysis of the scale deposit and information from previous similar treatments may be available.

Laboratory Testing

Complete laboratory testing on any deposit includes solubility tests, X-ray diffraction pattern analysis, spectroscopic analysis or direct chemical analysis. Representative condenser deposits usually consist of compounds with the following chemical compositions:

Water Side

Copper Oxide — Cu_2O
Basic Copper Chloride — $CuCl_2 \cdot 3Cu(OH)_2$
Copper Sulfide — Cu_2S
Calcium Carbonate — $CaCO_3$
Zinc Carbonate — $ZnCO_3$
Zinc Sulfide — ZnS
Iron Oxides — $FeOOH$ & Fe_2O_3
Silicon Dioxide — SiO_2

Steam Side

Copper Oxides — Cu_2O & CuO
Copper Sulfides — Cu_2S & CuS
Iron Sulfide — FeS
Iron Oxide Hydrate — $FeOOH$
Iron Oxide — Fe_2O_3
Iron Oxide — Fe_3O_4

Equipment Preparation

Necessary preliminary arrangements for condenser treatments are not complicated and become routine after several cleanings. The complete cleaning procedure consists of the following four basic steps: 1. Isolation and checking of condenser; 2. Filling and venting, 3. Draining and solvent disposal, 4. Flushing and washing.

The procedures required to isolate a condenser vary with each particular unit. The condensate side is usually isolated by means of existing valves or by the installation of slip-blanks. When valves are relied on, a drain valve or other fitting can be used to indicate leaks.

The water side is more difficult to isolate because of the circulating line sizes. Some of the sealing mechanisms used for the water sides are: 1. Existing valves; 2. Blanks in line; 3. Balloon baffles; 4. Steel sealing plates; 5. Wooden bulkheads.

Past practice has been to use blanks in the line or makeshift bulkheads when circulating water valves were corroded or could not be closed completely. Such bulkheads commonly consist of two layers of planks, with sealing materials between the layers and around the periphery of the line. Blanks and this type of bulkhead are not altogether convenient or successful and several other means have been devised.

Using the Balloon

One answer worked out in conjunction with a major rubber company consists of a rubber-covered-nylon pressure bag (Fig. 1). This bag is inserted in the circulating water line and inflated with air. Experience with these bags has proved this method to be inexpensive and effective. Recently, expandable sponge rubber strip has been used to seal any irregularities between the balloon baffle and the circulating line.

Inflation pressure of the bag is controlled by valves and a mercury manometer, outside the condenser. (Fig. 3) Usual practice is to drill and tap a water box inspection plate for the inside and outside air connections. Pressure used to inflate the bags is regulated between 3 and 7 psi, depending on the static fluid head. Additional bag supports should be

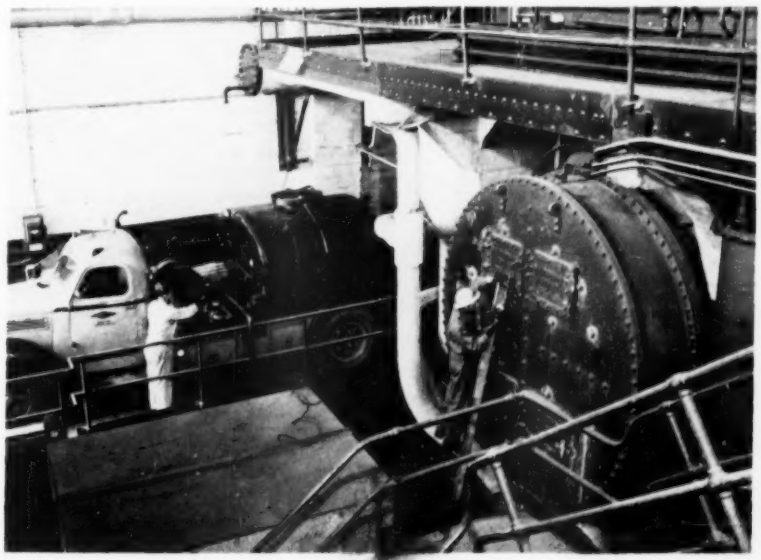


Fig. 4. Modern truck tanks, complete with auxiliary [illegible] and blending equipment, carry the pre-mixed concentrated cleaning solvent to the condenser, [illegible] is blended with hot water before using

used to prevent slippage in very large lines or at high static heads. Since the introduction of these rubber-covered-nylon bags, they have been used in more than 50 condenser treatments in the Cleveland Industrial Area over a four-year period. The balloon baffle technique was described in the April 1947 issue of POWER ENGINEERING.

An interesting sealing assembly is described by W. E. Adams of the Beech Bottom Power Co. at Power, W. Va. in the January, 1952, *Electrical World*. It consists of a sectional steel plate, assembled inside the water box and held in place by jack bolts against the overhead first-pass division plates. A ½-in. live rubber gasket is used for the sealing medium.

Special equipment used on some treatments includes a gage glass for solvent level indication on the water side. Another variation is a high volume pump, used for periodic circulation of the water side solvent. This provides more thorough cleaning where the deposit is high in calcium carbonate. When both the steam and water sides are to be filled with solvent, the construction of the condenser must be investigated to see if any further preparations are necessary for the unit to take the additional weight load safely.

Treatment Procedures

A typical piping arrangement for the cleaning of a high volume condenser is shown in Fig. 4. The premixed concentrated solvent is transported to the plant in tank trucks provided with auxiliary pumps and blending equipment. As shown in this illustration, water is heated with live steam in a jet mixing heater. It then is blended with the concentrated solvent and pumped, at the proper strength and temperature, into the unit being cleaned.

The solvent concentration to be used on any specific job is determined from the preliminary deposit tests, the volume of the unit and the amount of surface area to be cleaned. The proper concentration is calculated from these factors with a slight additional safety margin to ensure an effectively cleaned condenser. Cost is the principal reason higher concentrations are not used.

Table 1. Corrosion rates of condenser metals in 5 percent inhibited hydrochloric acid solutions

Type Metal	Lbs./Sq. Ft./Day @75°F.	@120°F.
Commercial Copper	.0015	.0017
Arsenical Copper	.0004	.0014
Admiralty	.0005	.0007
Naval Brass	.0005	.0008
Red Brass	.0005	.0007
Muntz	.0007	.0015
Aluminum Brass	.0004	.0013
Cupro-Nickel 70–30	.0003	.0006
Mild Steel	.0019	.0080
Cast Iron	.0206	.0340

Reference: Dow Chemical Co. Research Report 1798, page 32.

Table 2. Typical example of how chemical cleaning improves steam turbine surface condenser performance

Test No. [1]	1	2	3
Date	May 12	May 21	June 8
Indicated kw	30.0	31.5	32.0
Steam to throttle — M#/hr.	335.6	361.0	374.0
Steam to condenser — M#/hr. [2]	282.4	298.0	310.0
Water Circulated — GPM	45,554	49,200	46,000
Water Velocity — FPS	6.3	6.8	6.38
Temp. Circulating Water: °F.			
Inlet	65.0	72.2	75.6
Discharge	76.6	83.7	86.4
Exhaust Steam Temp.: °F. [3]	103.25	99.6	105.4
Absolute Pressure: Inches Hg [4]			
Actual	2.13	1.91	2.27
Guarantee	1.50	1.82	2.00
Deviation from Guarantee	0.65	0.09	0.27
Coefficient of Heat Transfer — U [5]			
Actual (Corrected)	326	551	508
Theoretical	658	683	663
Cleanliness Factor — %	49.5	80.7	76.3

NOTE:

[1] Test No. 1 — Unit had been in service 6 hours following outage for rubber plugging the condenser tubes.
Test No. 2 — Unit had been in service 26 hours following outage for rubber plugging the condenser tubes, followed by Dowell chemical cleaning service.
Test No. 3 — Unit in continuous service for 20 days with exception of 2 hour outage (June 3) for condenser tube sheet cleaning.

[2] Enthalpy of steam to condenser is assumed to be 950 BTU per pound.

[3] Corresponding to absolute pressure.

[4] Guarantee absolute pressure is based on a tube cleanliness factor of 85%

[5] Coefficient of heat transfer corrected for inlet water temperature and steam loading.

Reference: Standards of Heat Exchange Institute — Condenser Section.

Treating temperatures are based upon complete consideration of the condenser construction materials, possibility of temperature strains, and the results of laboratory solubility tests on the actual deposit. Ordinary condenser deposits can be removed at quite low temperatures. Most condensers are treated at temperatures below 130 deg F. Vents to the atmosphere are necessary for safe removal of displacement and reaction gases.

The length of the solvent soaking period is usually from 3 to 5 hours. It is determined from preliminary solubility tests made on the deposit and by the judgment and tests of the supervising engineer.

When there is no longer any reaction with the deposit, the solvent is drained. Disposal of the spent solvent is not difficult in areas where its volume is small compared with the circulating water volume. Solvents now being used are inhibited with non-toxic materials and are not harmful after dilution. In areas with restricted water supplies and disposal problems, arrangements can be worked out for neutralization before disposal.

Immediate flushing of the tube side and steam side with circulating water, by means of hoses, is desirable to remove any disintegrated deposit from the water side or residual film from the steam side.

Solvent drain samples can be analyzed if the customer desires an indication of the amount of deposit removed. Information obtained from these samples also is valuable in determining the amount of solvent required for a regular maintenance cleaning program.

The improved performance of a condenser after chemical cleaning usually pays for the cost of the treatment in a relatively short time. This is not the only benefit to be derived from chemical cleaning, but is the one most frequently considered to justify the treatment. More intangible factors are the value of downtime saved, a cleaner condenser, and prolonging the service life of the unit.

Too often, higher continuous loads and a disinclination to switch to newer cleaning procedures lead to inefficient operation of condenser units. A remarkable improvement in condenser backpressure often merely indicates that cleaning long was overdue. It has been shown that an improvement of even 0.2 in. Hg in back pressure will pay, in less than two months, for chemically cleaning the water side of a condenser.

It is true that many circulating waters are more erosive than they are corrosive or deposit forming. However, erosive conditions in some sections of the water side do not preclude completely the presence of corrosion products or deposits. In any case, investigation of the cleanliness factors may reveal that operations could be improved by cleaning the steam side.

Prior to the first chemical cleaning of the No. 1 condenser at the Dow Chemical Co. at Freeport, Tex., pneumatically driven rubber plugs had been used to remove silt and scale accumulations. This procedure was not completely successful in removing the dark brown scale, and after 20,000 service hours it was necessary to rod out many of the tubes.

After 25,000 hours, the coefficient of heat transfer had dropped to 330 Btu per sq. ft per hr per deg F, in

(*Continued on page 108*)

Power Engineering's

PRACTICAL ENGINEER and ELECTRICIAN SECTION

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Centrifugal Boiler Feed Pump Maintenance

Three preceding articles have dealt with the frequency and procedures for a complete boiler feed pump overhaul and the procedures for scheduled observation and maintenance. This fourth article tells how to determine critical measurements

By IGOR J. KARASSIK

Manager, Multistage Pump Section,
Centrifugal Pump Division,
Worthington Corporation

IT HAS BEEN stated in the first of this series of articles that a centrifugal boiler feed pump will be in need of a complete overhaul when internal wear has caused sufficient deterioration of the running clearances to affect the pump performance to an appreciable extent. Unfortunately, it is not possible to define the effect on the performance any more accurately than by the word "appreciable". This is due to the many factors which determine whether 50, 100 or 150 per cent increase in the running clearances — and hence in internal leakage — is permissible before the original clearances need be restored.

A 100-per cent increase in internal clearances is generally a reasonable amount of wear and, while renewal of parts is not necessary before such increase is observed, postponing the overhaul much beyond this time is not wise economy. The number of operating hours which can be expected from a pump before wear doubles the internal clearances must be deduced from past experience with similar equipment. The life of running clearances varies a great deal, depending on factors such as pump design, materials used, and load factors.

Strictly as a guide, the author's experience with high pressure boiler feed pumps designed with relatively rigid shafts and using stainless steels for both the rotating and stationary adjacent parts indicates that 50,000 to 60,000 hours of operation may be expected before the clearances double and renewal is indicated.

Preceding articles described the various means which could be used by the operator to determine the approximate internal condition of his equipment without the need of dismantling it for inspection and measuring inner parts. Some of these means involve relatively accurate testing of the hydraulic performance of the pumps in question. Others are based on the checking of the total vertical movement of the rotor after all obstructions, such as packing and bearings, have been removed.

Measuring Clearances

In many cases, internal clearances can be measured more accurately after removing the rotor from the pump casing, but without completely dismantling the rotor. If the wearing rings are of the flat type (A, Fig. 3), the clearance can be measured by inserting a feeler gage between the stationary and rotating parts. When L-type wearing rings are used (B, Fig. 3), the lip of the L prevents insertion of the feeler gage. An approximate check of the clearance still may be made in the following manner:

(a) Mount a dial indicator on the impeller shroud (as in Fig. 1) and, with the stationary ring resting on the impeller wearing ring hub, set the dial reading at zero.

(b) Leaving the dial indicator in position, push up on the stationary ring from below and make a record of the maximum dial reading. This corresponds to the diametral clearance.

Repeat this operation for every clearance joint and make a record of all readings.

Instruction books supplied by the pump manufacturer should be consulted to determine the original wearing ring clearances to which the running joints should be restored. In the absence of this information, data given in the accompanying table can be used as a guide.

These clearances are given basically for 2- or 3-stage boiler feed pumps with either single or double wearing rings. They are based on the assumption that the materials of the two parts making up the running joint do not gall easily, such as two dissimilar bronzes, bronze with stainless steel or cast iron with cast iron. If the running joint is made with combinations of materials which may gall — such as stainless steel with stainless steel, or monel metal with monel metal or with stainless steel — the recommended clearances should be increased by 0.002 in. Likewise for boiler feed pumps with four or more stages, where the shaft deflection is appreciably greater than with pumps of a lesser number of stages, the diametral clearances should be increased by 2 to 3 thousandths.

Renewal of Clearances

There are three methods to restore the wearing ring clearances of a pump

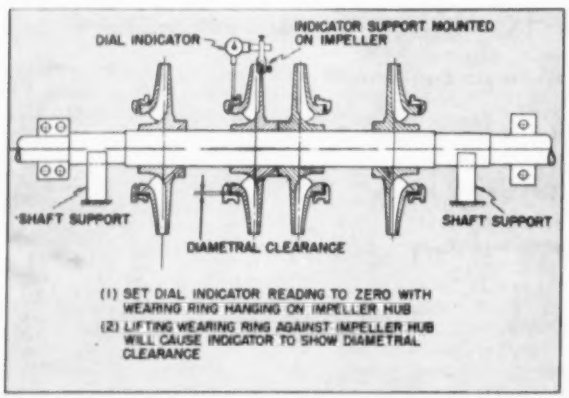

DIAL INDICATOR
INDICATOR SUPPORT MOUNTED ON IMPELLER
SHAFT SUPPORT
SHAFT SUPPORT
DIAMETRAL CLEARANCE
(1) SET DIAL INDICATOR READING TO ZERO WITH WEARING RING HANGING ON IMPELLER HUB
(2) LIFTING WEARING RING AGAINST IMPELLER HUB WILL CAUSE INDICATOR TO SHOW DIAMETRAL CLEARANCE

Fig. 1. Clearance may be determined by measuring movement of stationary ring when it is pushed up from below. Dial indicator is mounted as shown

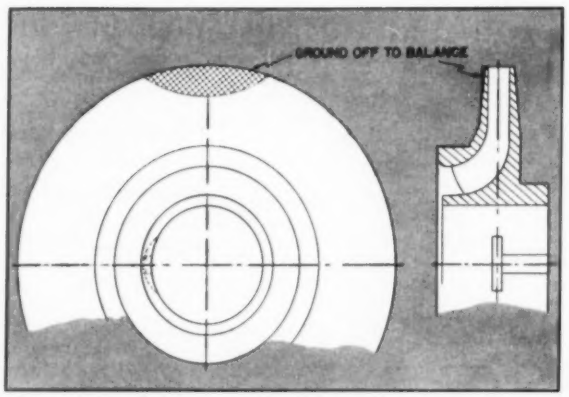


Fig. 2. To correct an unbalance in the impeller, remove material by mounting impeller off-center in a lathe and take cut. Never drill holes in impeller

with single wearing rings in the casing, whether they be of the flat ring or of the L-type:

(1) Use a new casing ring obtained from the manufacturer with an undersize bore and true up the wearing ring hub of the impeller in a lathe.

(2) Build up the worn surface of the wearing ring by welding or metal spraying so that it may be bored slightly undersize to match the wearing ring hub of the impeller after it has been trued up.

(3) True up the wearing ring by boring it oversize. Build up the wearing ring hub of the impeller by welding or metal spraying and machine it to give the correct clearance with the rebored wearing ring.

Of the three methods, the first generally is preferred and can be carried out several times in succession before the wearing ring hub of the impeller is too thin. In some cases, as a matter of fact, after the impeller hub has been machined down several times, it may be possible to shrink on or otherwise mount a thin impeller ring, to eliminate further machining of the impeller, and to obtain further service from it.

Methods (2) and (3) are rather difficult to execute satisfactorily and are only feasible and practical if proper equipment is available so that the work can be done on the premises. Otherwise the procedure becomes uneconomical by comparison with the first method. Of course, there may be a justification in resorting to either of the last two methods in the case of an emergency when immediate repairs are necessary and no spare parts are available.

Check for Distortion

A number of power plants, however, have reported to the author that they constantly repair worn clearance joints by building up the surfaces either by spraying or welding. If the experience with such repairs is satisfactory, the decision between purchasing replacement parts and rebuilding worn parts should be based strictly on the relative economics of the two methods.

A note of caution is necessary regarding the possible distortion of important machined surfaces, such as the impeller bore at the shaft or the machined fit of the wearing ring in the casing. Any repair procedure which involves the heating of the pump parts should be followed by a thorough check of machined dimensions and of the perpendicularity of bores and shoulder fits.

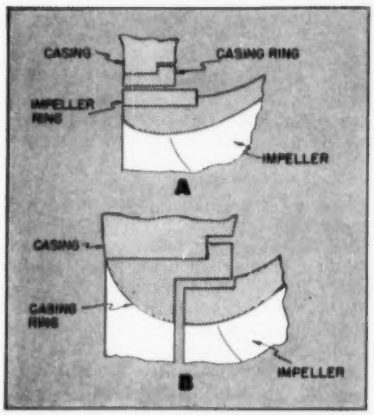


Fig. 3. (a) Flat leakage joint with double wearing rings. (b) Single casing wearing ring of the L type

If the boiler feed pump is provided with double rings of the flat or L-type, the clearances may be renewed by one of the following methods:

(1) Obtain a new oversize impeller ring and bore out the old casing ring to true it up.

(2) Obtain a new casing ring bored undersize and turn down the old impeller ring.

(3) Renew both rings if necessary.

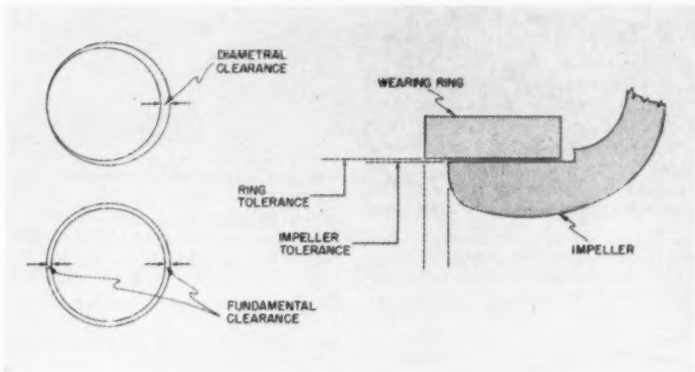
(4) Build up either the casing or impeller ring by welding or metal spraying and machine the other ring to true it up.

Comments as to the relative merits of the methods used to restore single wearing ring construction pumps apply as well to the four methods given for double-ring type pump repairs. It should be stated, however, that if method (1) is followed on the first repair, method (2) should be used for the second repair to get the most economical returns from the spare parts purchased. Likewise, if the rings are built up, casing rings and impeller rings should be rebuilt alternately in successive repairs.

Labyrinth ring construction generally makes use of double wearing rings, the impeller ring being screwed to the impeller. Repair of such rings is very difficult and, after excessive clearance develops, replacement of both rings is advisable in most cases.

Generally, whether the impeller ring be pressed on, shrunk on, bolted to, or screwed on the impeller, it will be found that the wearing ring surface is no longer concentric with the shaft axis after the ring is mounted on the impeller. This surface always should be checked for concentricity, therefore, and a slight truing-up cut taken if necessary.

Table for 2- and 3-stage pumps with bronze wearing rings (all the measurements given are in inches)



Range (Diameter)	Tolerance Range		Fundamental Clearance	Diametral Clearance	Range for Diametral Clearance
	Ring	Imp.			
2 to $3\frac{15}{16}$	$+0.002$ -0.000	$+0.000$ -0.002	0.006	0.012	0.012 to 0.016
4 to $5\frac{15}{16}$	$+0.002$ -0.000	$+0.000$ -0.002	0.007	0.014	0.014 to 0.018
6 to $7\frac{13}{16}$	$+0.002$ -0.000	$+0.000$ -0.002	0.008	0.016	0.016 to 0.020

Note: If rings are for 4- to 6-stage pumps, increase all clearances by 0.002 in. diametrically up to and including 6-in. diameters. For diameters above 6 in. increase clearances by 0.003 in. diametrically.

Illustration of use of clearance table

Ring tolerance (or bore) = $6.000\ ^{+0.002}_{-0.000}$ inches

Impeller tolerance (or turn) = Diameter minus twice the fundamental clearance plus impeller tolerance range.

For example: 6-in. diam $- 0.016$ in. $+\ ^{+0.000}_{-0.002} = 5.984\ ^{+0.000}_{-0.002}$ in. turn

Note: For stainless steel increase fundamental clearances by 0.002 in.

Impeller Maintenance

After removal from the rotor, impellers should be examined carefully for signs of unusual wear in addition to possible wear at the running joints. For example, a first stage impeller may show signs of cavitation wear, which manifests itself through pitting in the suction eye area, and, sometimes, in the thinning-down of the vanes. In addition, wear caused by corrosion may show up in impellers made of materials other than stainless steel. If such corrosive wear is negligible, replacement by stainless steel impellers may not prove necessary. However, the longer life which can be obtained from stainless steel impellers makes such substitutions justifiable even in many doubtful cases.

Another area which may be subjected to wear is the bore over the shaft mounting or at the keyway. If leakage takes place between the shaft and the impeller, the former generally will suffer the brunt of the wear since it is made in most cases of a material less resistant than the impellers themselves. Wear at the keyways will develop if the impeller is too loose on the shaft or if the key is not fitted properly.

Unbalanced or Cracked Impellers

Finally, impellers may develop cracks either because of excessive vibration or from casting strains undetected when the impeller was machined. It has been found that cracked impellers cannot be repaired successfully and should be replaced.

Impellers removed from the pump rotor during an overhaul should be rechecked for balance. They should be mounted on an arbor placed on two parallel and level knife edges. If an impeller is out of balance, it will turn the arbor and come to rest with the heavy portion down.

Metal will have to be removed from this heavier portion. However, drilling holes in that portion of the impeller definitely is not recommended, as it will result in eddy currents which affect pump performance and will accelerate erosion of the impeller. The best practice is to mount the impeller slightly off true in a lathe and take a cut from the shroud, the cut being deepest at the periphery, as shown in Fig. 2. The cut may be made on either one or both of the shrouds, depending on the shroud thickness and the amount of metal to be removed.

How to Adjust Specific Gravity of Repaired Batteries

IT IS OFTEN necessary to adjust the specific gravity of industrial storage batteries which have been repaired because of leaks, spills, or overflowing. In such cases, the electrolyte is lost. Acid must be added to the battery to restore it to the correct specific gravity. Follow these recommendations by Gould-National Batteries, Inc., for best results.

Only sulphuric acid should be used and only sulphuric acid specified "For Storage Batteries". Storage battery acid can be obtained from any of the larger manufacturers of sulphuric acid.

If the decrease from normal specific gravity is slight — 15 points or less — acid of 1.300 sp gr may be added instead of water for several additions over a period of time until the battery is back to the proper gravity.

When you wish to raise gravity more than 15 points, remove some of the electrolyte from the cell and replace it with 1.400 sp gr acid. After the normal charge, keep the cell on charge at the finishing rate while adjusting the acid, so that the evolved gas will stir and mix the acid with the remaining electrolyte. One half to one-hour charge is required to mix the acid thoroughly with the liquid already in the cell.

If the fully charged sp gr of a cell is found to be above normal, adjust downward by removing some of the electrolyte and replacing it with pure water. Guard against specific gravities above 1.310 because the battery may be injured.

Here are some tips that will help in mixing and adding acid properly.

The amount of 1.280 sp gr electrolyte required per cell can be determined by multiplying the number of positive plates in the cell by the constant given in Table I.

Sulphuric acid usually is sold in either 1.835 or 1.400 sp gr concentration for storage battery use. To change the sp gr to another value, it is necessary to mix it with pure water. Always add the acid to the water and not water to acid when mixing. Add the acid in small amounts, stirring constantly. Heat usually develops when mixing acid with water. The mixture should be cooled to 100 F or below before adding to the cell. Pouring a hot mixture in a cell may injure it.

Table II will be useful in mixing acid with water to obtain electrolyte of the desired sp gr.

Table I. Electrolyte required by different types and capacities of batteries (Courtesy Gould National Batteries, Inc.).

Type of Cell	Amp. Hr. Cap. per Pos. Plate	Lbs. Per Pos. Plate 1.280 Sp Gr
KMZ	34	1.6
KTZ	40	1.6
XVLZ	40	1.6
KHZ	55	2.3
XLZ	55	2.3
KRZ	100	5.0
XRZ	100	5.0

Use this table to determine the pounds of 1.280 sp gr electrolyte required per cell. For instance, if you have cells with 40 amp. hr. capacity per positive plate, multiply the numbers of positive plates in the cell by 1.6 to arrive at the pounds of electrolyte at 1.280 sp gr required per cell (1.280 sp gr acid weighs 10.7 lbs gallon) (1.835 sp gr acid weighs 15.3 lbs per gallon.)

See Table II for water-acid mixtures needed to obtain 1.280 sp gr electrolyte.

Table II. Water-acid mixtures required to obtain electrolyte of various specific gravities (Courtesy Gould National Batteries, Inc.).

Parts Water Required per Part 1.835 Acid	Specific Gravity Desired 77 F	Parts Water Required per Part 1.400 Acid
1.78	1.375	0.075
1.86	1.365	.11
1.94	1.355	.14
1.975	1.350	.16
2.08	1.340	.20
2.17	1.330	0.24
2.22	1.325	.27
2.33	1.315	.31
2.42	1.310	.33
2.52	1.300	.38
2.65	1.290	0.43
2.70	1.285	.46
2.79	1.280	.49
2.84	1.275	.53
2.92	1.270	.56
3.10	1.260	0.63
3.18	1.255	.67
3.26	1.250	.70
3.38	1.245	.74
3.46	1.240	.78
3.67	1.230	0.85
3.80	1.225	0.905
3.91	1.220	0.96
4.03	1.215	1.00
4.15	1.210	1.05
4.26	1.205	1.11
4.43	1.200	1.16

"If Mr. Smythe says it's a busted bearing, you better find a busted bearing. If you can't find a busted bearing—bust one."

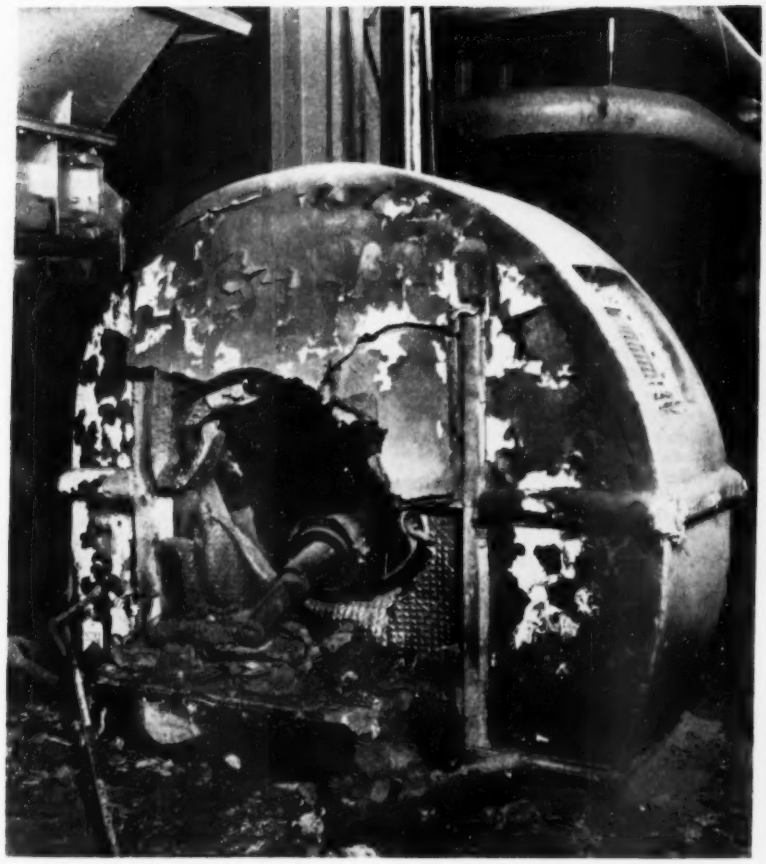


Fig. 1. An explosion, caused by or causing impeller failure, followed by a dust fire wrecked this fan

You never can relax completely in a power plant—even an automatic plant in which everything runs smoothly. You never know when the peace will be shattered by an item like a

. . . Blow Torch in a Fan

ON A SUNDAY afternoon, April 26, 1953, at about 5:35 P.M., things were very peaceful at the Trenton Channel Plant of the Detroit Edison Co. This condition changed rather suddenly, however, when the following series of events commenced:

There was an explosion or slight unbalance in south primary air fan of No. 17 high-pressure boiler. This was sufficient to tear out the bearing, the pedestal, and part of the housing on the end opposite the motor.

A piece of the fan blading was thrown into the discharge duct where it knocked out the lowest quarter-section of the damper.

The north primary fan, which discharges into the same duct, began blowing back through the damaged south fan. A quantity of coal dust had collected in the discharge duct because of a plugged burner on the boiler.

This dust was picked up by the air blowing across it and carried up through the south fan, where sparks caused by metal-to-metal contact ignited the mixture. This created a "blow torch" effect which caused such intense heat that molten metal from the fan housing and impeller was sprayed onto nearby equipment.

The boiler was banked immediately upon discovery of the fire, but enough time had passed to allow damage.

What would have happened if the coal dust had not ignited immediately and first had filled the room? The mishap, as bad as it was, was within a hair's breadth of being a major explosion in the power house.

(*Photos Courtesy The Detroit Edison Co.*)

Fig. 2. Bearing pedestal (right foreground) was blown off by the force of the original explosion

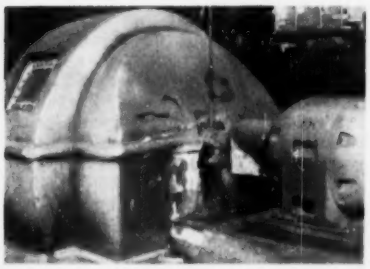


Fig. 3. Charring of outside insulation indicates intensity of the heat. Note hole under the shaft

Fig. 4. Outlet duct below the fan shows where a piece of the impeller knocked out damper section

Fig. 5. Fire fanned by north primary fan roared through south unit by way of connecting ductwork

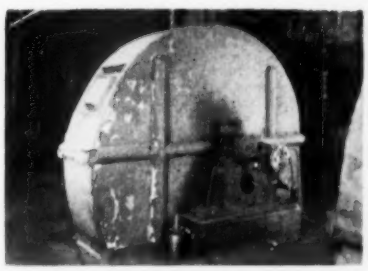


Fig. 6. Molten metal from south fan sprayed over adjoining equipment. Note spray on nearby fan

Re-Face Your Pipe Flanges In Place

By F. E. RILEY

A PORTABLE MACHINE for facing pipe flanges, shown in the drawing, first was designed for use by a manufacturing firm which had to face-off flanges already assembled on pipes which often were bent to odd shapes. By its use, it is possible to take a light skimming cut over flanges up to 10 in. in diameter without having to mount the pipe assembly in a horizontal boring machine.

This had been the practice prior to completion of the facing machine, and the time taken in setting up pipe assemblies in the boring machine was several times that needed to take the actual cut. Also, the facing operation tied up the boring machine for long periods when it might be used profitably on other work.

Maintenance and installation men in the firm heard about the new flange facer and made many attempts to borrow it for use out in the field and for general plant maintenance, since it was found possible to use the facer on a pipe flange which was in its normal working position up on its brackets. A second model of the pipe facer was made for use by the maintenance and erection crews, therefore, so that the production department could have exclusive use of its own machine.

Advantages of the flange facer are that it is not too heavy for a man to place in position single-handed, and that it can be used on a flange which is placed very close to a wall or other obstruction. In fact, the machine can be attached to a flange whose perimeter is within about 2 in. of a wall or ceiling. By its use, a pipe flange can be re-faced in position if the mating flange can be moved endwise or away from it enough to permit the 10½ in. length of the facer itself to be fitted in position. This is a much easier task than taking down complete lengths of pipe from their mountings and transporting them to the machine shop for re-facing.

Welded steel is used to construct the facer. This produces a strong and light assembly which can be put together very quickly by firms having welding facilities available. Backbone of the machine is an L-shaped beam of I section welded up from flat plate, and it carries a pair of clamps at one end for securing the machine to the outside diameter of the pipe. The short end of the L carries the rotating facing head.

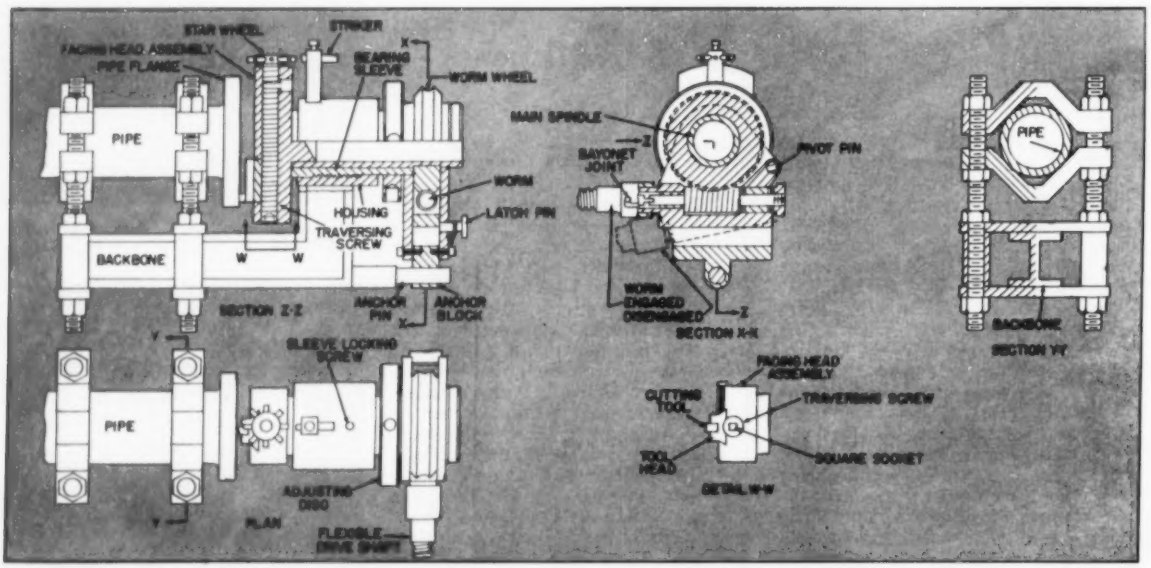
Clamps are made with plenty of room for adjustment and are used by clamping the steel V-shaped portions to the pipe first and then adjusting the I-beam up and down the screwed studs in order to bring the axis of the facing head into line with the pipe axis. Because of the clearance provided in the parts which fit on the screwed studs, it is possible to adjust the machine on the pipe so that the plane swept by its cutting tool is parallel to the existing flange face.

In cases where the outside pipe surface is rough, bits of shim can be inserted under the gripping surfaces of the clamps where they bear on the pipe so that alignment of the cutting tool path with the plane of the flange face can be assured. It is admitted that setting of the machine on the pipe can be time-consuming, but if it is desired to clean up the flange face without removing a large amount of metal unevenly, it is necessary that some time be devoted to careful setting. It is possible that a more easily adjusted clamping means could be devised but the alternatives suggested proved expensive to make.

Close-Mounted Tool

The cutting tool is designed to move progressively across the flange face as the facing head, in which it is mounted, is rotating. The tool consists of a high tensile steel shank with a cemented carbide tool tip brazed in place. The tool shank lies parallel to the flange face so that only a short portion carrying the carbide tip projects from the sliding tool holder. This L-shaped shank arrangement allows an adequate length of tool shank to be gripped while reducing overhang to a minimum. An idea of tool shape can be gained from section Z-Z and detail W-W in the drawing.

A longitudinal slot in the sliding tool head accommodates the tool shank which is held therein by three headless socket screws. A cross-section of the sliding tool head is shown in detail W-W, and can be seen to incorporate a normal dovetail shape for the slide with a gib strip for adjusting the friction. The head slides within a dovetail section slot running along the length of the facing head and has an accurate thread section machined in its back face to engage the traversing screw. This screw runs for the full length of facing head and is retained in place axially by means of a thrust plug engaging with a groove. The screw and thrust plug



This portable pipe flange facer clamps onto the pipe and feeds a carbide-tipped tool bit across the flange on a rotating head; it requires external power

arrangement is similar to that used for mounting a jaw in an independent lathe chuck.

Moving the tool head across the facing head is accomplished by using the old method of the star-wheel and striker to rotate the traversing screw. The star wheel is fitted on the end of the screw where it projects from one side of the facing head and engages a striker fixed to the stationary body of the machine. Striker engagement with the star wheel can be adjusted by sliding it in its mounting block to alter its position. Hand traversing of the tool head across the facing head, for setting or for starting another cut, is achieved by engaging a square-ended wrench with a socket in the end of the traversing screw.

Bearing Integral With Body

Integral with the rectangular-shaped facing head is the main spindle, which is hollow in order to cut down its weight. The spindle runs inside a long bronze bearing sleeve which is threaded externally and has plain guide portions at both ends.

The bearing sleeve is screwed into a thread machined in the bearing housing to become part of the machine body. This screw-in sleeve arrangement is a simple means of adjusting the spindle axially in relation to the pipe flange to be faced, thus advancing the cutting tool and facing head toward the flange in order to make the cut.

The sleeve is rotated in order to adjustment engagement of the cutter by means of a disc keyed to it. The disc has holes drilled at intervals in its periphery to allow insertion of a short piece of bar to assist turning it. Once set, the sleeve is locked by tightening a locking screw which bears on the exterior.

Power drive for the facing head is obtained from a flexible-shaft driving unit which may stand on the floor or any other surface near at hand. A unit of 1 hp has been found adequate. The unit which is most useful for driving the flange facer is mounted on gimbals on a floor stand and has a 3-step cone pulley drive interposed between the electric motor and the flexible shaft so that some degree of speed control is obtained.

Connection of the flexible shaft output end to the pipe facer is by means of a bayonet type joint which enables the shaft to be connected to the worm of a worm reduction unit built into the machine. The worm wheel is keyed to the main spindle and its general form can be seen in section X-X of the sketch.

The worm wheel is enclosed by a pair of flat plates which have holes engaging with the main spindle. The plates project downward and terminate in an anchor block which also acts as spacer between them. The lower part of the anchor block has a downward-projecting lug, drilled to engage with a horizontally-projected anchor pin attached to the machine frame. The pin prevents the plate and anchor block assembly from rotating while allowing them to slide with the spindle as it is adjusted endwise for making the cut.

An arrangement is provided for dropping the worm out of engagement with the worm wheel so that the spindle may be revolved freely by hand when setting the machine in position on the pipe to be faced. The worm carrier is mounted upon a pivot pin and is held in engagement by means of a simple spring-loaded latch pin. Pulling the pin outward disengages it from the underside of the worm carrier and allows the worm to drop out of engagement with the worm wheel.

Set-Up Procedure

Procedure when setting up the machine on a pipe is as follows: Clamp the machine to the pipe with the spindle screwed back as far as possible. The distance between tool point and flange face should not then exceed $\frac{1}{4}$ in. Adjust the machine in relation to the pipe flange so that a scribing point stuck on to the tool head with a piece of modeling clay touches the flange face at several points. The worm is dropped out of gear for this so that the spindle may be rotated by hand.

Start the flexible shaft drive motor and raise the worm into gear so that the spindle and facing head start rotating. The cutting tool now can be brought into contact with the flange face and the depth of cut adjusted by means of the disc. The setting is fixed by means of the locking screw. Feed of the tool head is engaged by sliding the striker axially so that it contacts one of the pins projecting from the star wheel at each revolution and rotates it through one-eighth of a turn per revolution. The cutting tool thus will travel progressively across the flange face.

With the star wheel system of traversing, the cut is applied at the same place during each tool revolution and to avoid objectionable marks, the cutting tool should be ground so as to have a scraping action rather than a narrow point effect. On cast iron pipe flanges a very high degree of surface finish can be obtained by using a scraper tool. If there are deep corroded places in the pipe flange which have to be machined away, it is better to make an initial heavy roughing cut followed by a fine scraping cut for finishing.

If registers are incorporated in the pipe flange they should present no problem if the spindle axis is adjusted so as to be concentric with them when setting the machine on the pipe. The tool can be traversed close up to them and the worm dropped out of engagement just before the tool runs into the register.

Grooves and recesses also can be machined in pipe faces by fitting correctly shaped cutting tools in the tool head and using the spindle feeding sleeve to make axial cuts.

Metal Flex-Hose Connections Stop Pump Bearing Strain

FLEXIBLE metal hose solved an oil pump maintenance problem for Wheatena Corp., Rahway, N. J., and the manner in which it was used may serve as an idea-starter for maintenance men with similar problems.

In making Wheatena, grain is roasted in large vats in two roasting rooms. The vats are fired with fuel oil, which must be pumped from ground level to the fourth-floor roasting rooms. Each room is supplied by its own pump.

Solid pipe connections, previously used on these pumps, would tend to throw the pumps out of line with the motors when they were drawn up tight enough for a safe connection.

A fraction of an inch extra length in these two flexible metal hoses has cut repacking of pump's bearings from twice each year to none in 5 years

This put considerable strain on the pump bearings and it was necessary to repack the bearings on each of the pumps twice each year.

W. J. Hein, maintenance superintendent at the Wheatena plant, decided that flexible metal hose connections would solve his problem. (Rubber was ruled out because it would be attacked by the fuel oil.) The installation was made five years ago. The pump bearings have not required repacking once since that time.

Wheatena has replaced rubber hose connections on its cooling towers with flexible metal hose to solve another different problem. Hot recirculated water would cause the rubber to swell and make it difficult to control the amount of water circulating through the cooling system. All-metal flexible hose not only eliminated the swelling and gave an even flow of water, but — because of its flexibility — also allowed the towers to be moved for cleaning without disconnecting the lines.

PRACTICAL HINTS AND KINKS

How about the gadget you made or the trick you used to do your job better? Write us about it. Send a sketch too. You will be paid well for contributions.

Coal Level Alarm

By L. W. GREENE
Instrument Engineer

A CHEMICAL processing plant in New Jersey has a power house typical of older plants throughout the country. The boilers are stoker fed, the coal feed coming from hoppers filled by a coal lorry. Studies revealed that it would be desirable to have a reliable alarm device to indicate when the coal level in these hoppers dropped below a given point.

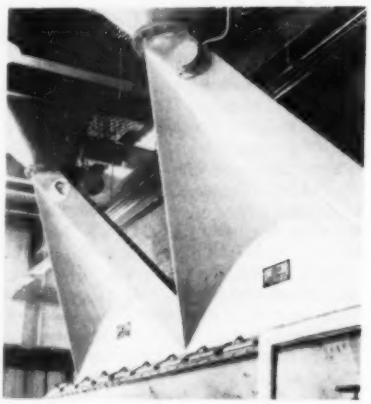
Past experience indicated that commercially available equipment left much to be desired. On some units, the moist coal would build up on the sensing diaphragm and prevent proper operation. On others of different types, abrasive coal wore out the sensing element very quickly. The instrument mechanic charged with the maintenance of this equipment, E. J. Scray, decided that if no one would design a decent unit for this service, he would do it himself.

To provide resistance to abrasion, he used a stainless steel rod for the sensing element. For the transmitting element he used the reliable micro switch. The biggest problem remained to be solved — that of providing a reliable pivot and seal mechanism (this is the problem which had remained unsolved until now). He designed one ingenious unit to do this job, and that was a resiliant sphere. The sphere provides a friction-free pivot and at the same time provides a positive seal.

One unit of this design was built and installed. It proved so satisfactory that similar units were built and placed on all of the coal chutes. The original unit has operated satisfactorily for over three years. It is particularly good on wet coal. The round stainless rod has no surfaces on which coal dust or wet coal can build up. Maintenance is limited to replacement of the rod when it wears down. On services similar to the original installation this may occur after four or five years of service.

If you wish more information on this unique device, write to The Editor, POWER ENGINEERING, 110 S. Dearborn St., Chicago, Illinois.

Cut-away view of alarm shows flexible sphere and spring-loaded stainless steel rod sensing element



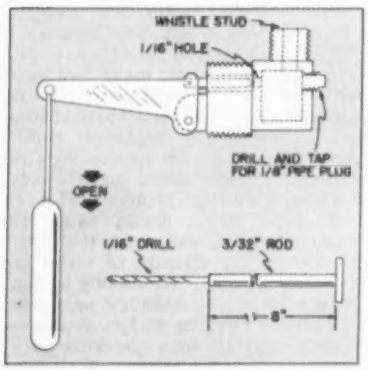
Installed view showing two of the devices located on the coal chutes. Cover of unit at left is off

When the Whistle Won't Whistle

By GEORGE O. WHEATLEY

ACCOMPANYING SKETCH of a low water alarm whistle shows how it was modified to overcome the outage of boilers due to the plugging of the 1/16-in. orifice in this valve. One of the safety features on our boilers, it is necessary to keep it in working order and when it becomes plugged, that particular boiler is cut out, cooled down, the water column opened, the valve removed and a drill passed through the orifice.

This in the past has been the cause for extra maintenance work on the part of two men. Now we merely cool the particular boiler down, remove the 1/8-in. plug, open the water column drain, which causes the float to drop and open the whistle valve, insert a 1/16-in. drill which has been welded to a 3/32-in. rod with a "T" handle and reopen the orifice. This plug is replaced and the boiler is ready to be fired.

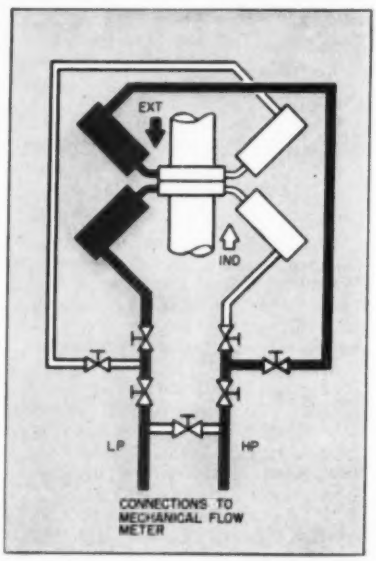


A hole drilled in the water level valve body is unplugged to facilitate fast cleaning of orifice

Reversible Flow Meter

AN EXTRACTION turbine which either supplies steam to a 200-psi header or inducts steam from that header is a little out of the ordinary. The way that the City of Holyoke Gas and Electric Department solved the turnabout metering problem is even more so. One mechanical flow meter is employed to measure and record steam flow to or from the turbine.

By installing two sets of pipe taps, they provided a high pressure and low pressure tap on each side of the orifice. Pairing these by the valve arrangement shown in the accompanying illustration allows the operator to record extraction steam when the turbine is supplying the 200-psi header. Reversing the valve settings permits recording of the secondary steam supply when the turbine is operated as a mixed-pressure unit.



Piping and orifice arrangement for the reversible flow meter. Taps are in the orifice plate flange

Questions and Answers

Your fellow engineers will answer your power plant questions. You answer theirs, get paid well. Simple? Effective? Why don't you try it?

Question No. 513

Can He Use Air-Cooled Steam Condenser?

OUR INDUSTRIAL plant now is buying about half its electric power and generating the other half with a very old back-pressure steam-engine-driven generator. Maintenance and repair costs on this engine are going up. So the question has come up as to whether or not we could replace it with a 1000-kw extraction condensing steam turbine generator with one extraction point to supply process steam at 10 or 15 psi. Our boilers are designed for 450 psig, but we have been operating them at 175 psig.

Our preliminary estimating indicates such a turbine would give us a good process steam and electric balance. But there is one rub: Our supply of condenser circulating water is very limited and besides is badly contaminated. The water we would save by discontinuing use of our 700-hp non-condensing engine would be a drop in the bucket compared to the amount of condenser water we would require.

It has been suggested, of course, that we could use a cooling tower, but then it occurred to me that recently in POWER ENGINEERING I had seen an article on how air-cooled steam condensers were used in some plant 60 miles from water.

Would it be possible for us to use an air-cooled steam condenser under our conditions? How would we figure the amount of air required, which I understand is supplied by induced draft fans at the top of the unit? How about fan power consumption? How would we figure the vacuum such a condenser would pull at full and partial loads and at various steam extractions?

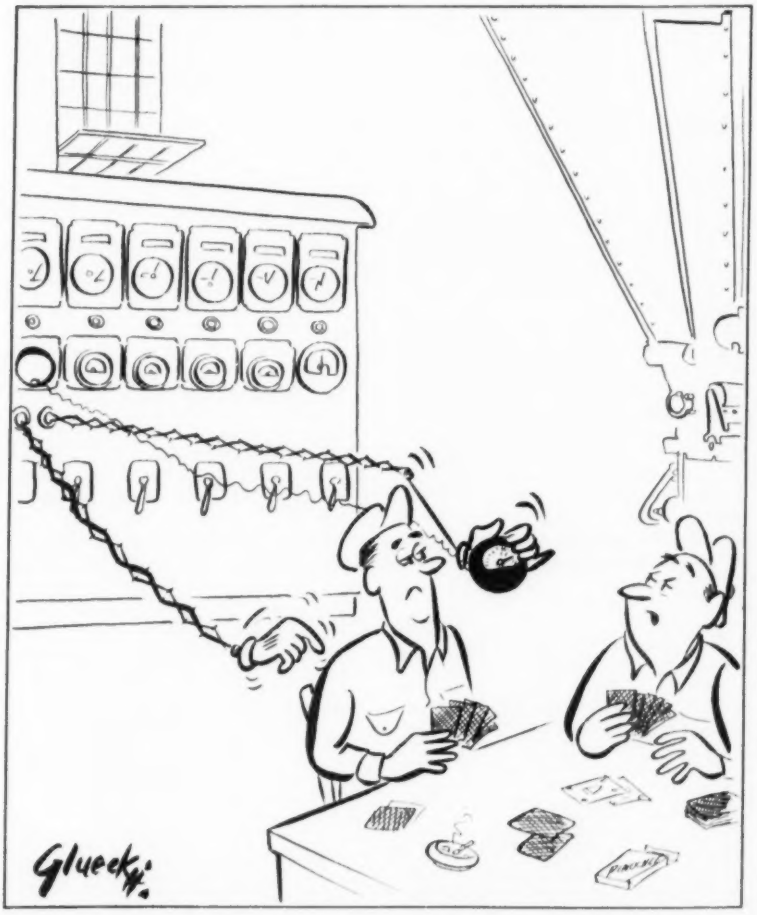
It would be necessary to make some estimate of these before we decide to install or not to install the turbine-generator. Any help Q&A readers can give us, by indicating how to do this, will be greatly appreciated.

Pennsylvania — A.L.A.

Editor's Note: — *Of course there is not enough information given in the above question. We should have a heat-balance diagram, also some data on the contamination of the water and the amount of circulating water actually available. What is his boiler feedwater make-up source now?*

But perhaps, by making a few assumptions about water rate of the turbine and similar data, readers might give this engineer a method for solving his problem.

The article he refers to about air-cooled condensers was entitled "Air-Cooled Condensers Service Eunice Plant — 60 Miles From Water," by Griffen and Hoover, POWER ENGINEERING *October 1951, page 68.*



"Quit gripin' and be thankful it ain't learned to play pinochle yet."

Question No. 514

What Caused Water Level Irregularities?

SEVERAL DAYS ago the 12 to 8 a.m. shift, with a well-qualified fireman on the job, had some trouble which led to much discussion and many theories as to why and how it occurred. Perhaps some Q&A readers can submit theories or actual experience of their own to help us out.

The conditions and events were as follows:

(1) Two 600-hp boilers were on the line, one supplying steam to a turbine generator.

(2) Power load was light, with one boiler operating at 100-percent boiler rating.

(3) At 5:00 a.m., cooking steam to kitchen was turned on. Normal load increase is 4000 lb per hour.

(4) The boiler did not supply sufficient cooking steam to line, but boiler pressure was above normal and the safety valves popped.

(5) Forced draft fan speeded up; it is controlled by line pressure.

(6) Boiler feed pump slowed down; it is controlled by Fischer differential steam governors (pumped water pressure against line steam pressure).

(7) Water dropped out of sight in water glass and stayed out for several minutes. Water returned to glass, but its level was not steady. The condition resembled priming as it was described to me.

(8) Boiler feed pumps kept running, but it was noted that operation was too slow.

The chart readings during this period were as follows:

(1) Line steam pressure — down 15 to 20 psi from normal of 175 psi; remained there until other boiler was

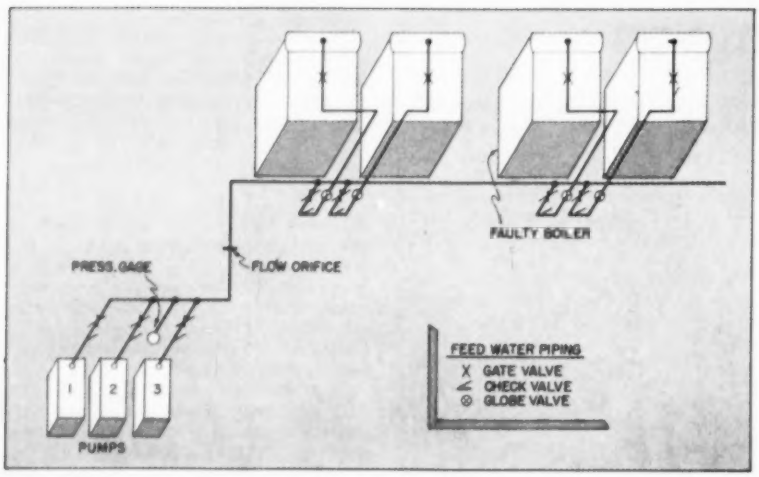


Diagram of feedwater piping system which has M.E.R.'s operators' heads spinning. Can you help them?

put on line, and then raised.

(2) Boiler steam gage — raised to 187 psi; safeties would pop and lower pressure to 173 psi.

(3) Boiler flow meter — showed a continuous fluctuation of from 100 to 90 percent in close intervals, with a gradual lowering of output (over a ½-hour period).

(4) Total output flow meter — (on outgoing header) a slight increase in output at 5:00 a.m. (2000 lb per hour) and then dropped back to the previous reading.

(5) Boiler feedwater flow meter — fluctuation from 20,000 to 70,000 lb per hour was indicated, but it is believed that this is a false reading. This erratic condition has been noted many times before, but it has not caused concern other than that it showed conditions that did not exist. At 5:00 a.m., a gradual drop of flow was indicated for 10 minutes or so, then the erratic condition previously mentioned returned and continued for 20 minutes or more.

(6) Feedwater pressure gage — showed pressure greater than or equal to boiler pressure during the entire period.

The load was changed to another boiler and everything came to normal in a short time. When the boiler was removed from service, the following facts were discovered:

(1) The Anderson non-return valve was stuck on the stem (part way open). The shot pot of the valve was stuck open.

(2) Soft plug was found to be sound.

(3) All other points of inspection seemed normal.

Seven hours later, the pump piston parted company with the rod and was removed from service. The break was a clean, crystalline break which appeared to have pulled apart. The break was very nearly horizontal from piston edge to hub edge. The pump was a cup packed pump (12 x 8½ x 12 duplex) and was running at about ⅓ capacity. Water temperature at suction is between 180 and 202F. The feedwater line is a 3-in. line 100 ft long. The line is constructed as shown in diagram.

The following questions are those which bother our operators:

(1) Why did the pump discharge pressure show equal to or above boiler pressure when the pump slowed down?

(2) What was happening to the water that was being pumped (if any) when the differential governor was being operated by reduced line steam pressure over a differential of the normal boiler drum pressure?

(3) Why did the water leave the glass and then come back a few minutes later and pump speed did not increase due to the steam line pressure?

(4) Why was water level erratic?

(5) What caused the flow meter on the feedwater line to indicate that a large quantity of water was being pumped when the operator could see from the pump speed that this was not true since no quantity as large as that indicated could possibly have been delivered at that speed?

New Jersey — M. E. R.

Answer to No. 507

Expansion Joints vs. Expansion Loops

Steinert has the Dope

IN REPLY to question 507, Expansion joints vs Expansion loops, I offer the following experience.

Corrugated expansion joints are compact, rugged, and require little or no maintenace once they have been properly installed and tested. The standard joints listed are limited to a maximum of 300 psi. I personally would hesitate to use them above this pressure.

Expansion bends are shop fabricated (tailor made) for your particular requirements. The type chosen depends on the amount of expansion in your lines. As an example, with 125 lb, steam, you can roughly estimate 2½ in. per 100 ft of piping so a 6 in. traverse joint will accommodate 240 ft of pipe.

The simple bends are roughly equal in cost to corrugated joints, while the more elaborate bends are slightly more expensive. The cost information comes from the Walworth Catalog 47. To figure the cost of a bend, you take the cost of the pipe, cost of flanges (if used) add the labor charge for bending and for welding. If you eliminate the flanges and weld the bend directly into the line, which I would recommend, then you can deduct not only the saving of the two flanges and the welding charge but you also save two more flanges and two welds in your line.

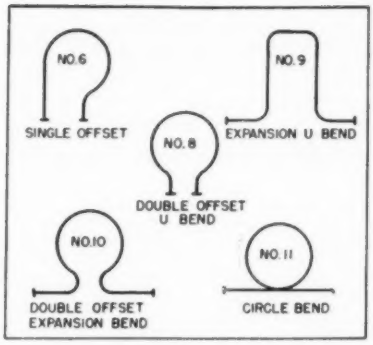
My personal preference would be to have all fabricated bends welded into the lines. They are then an integral part of the piping and can be forgotten as long as the pipes last.

In 1948 I took charge of a brand new central heating plant. We have over 10,000 ft of hp underground steam mains. At regular intervals we have a pit in which we have our expansion joints. In 1950 we discovered

Table compares 1950 costs of fabricated expansion bends and equivalent corrugated expansion joints

Pipe Dia.	Type Loop	Bending labor	2 Flanges	Welding labor	Pipe per ft	Total	Corrugated Expansion Joint
6"	# 6	$117.00	$27.00 ea.	$31.00	$1.92	$259.60	$260.00
8"	# 6	173.00	44.00 ea.	41.00	2.50	377.00	350.00
6"	# 9	123.00	"	"	"	265.60	"
8"	# 9	183.00	"	"	"	387.00	"
6"	# 8	136.00	"	"	"	278.60	"
8"	# 8	201.00	"	"	"	405.00	"
6"	#10	183.00	"	"	"	325.60	"
8"	#10	219.00	"	"	"	423.00	"
6"	#11	183.00	"	"	"	325.60	"
8"	#11	219.00	"	"	"	423.00	"

(assumed 30-ft pipe in all cases)



Sketches by Steinert show typical expansion bends for piping. Refer to table for cost figures

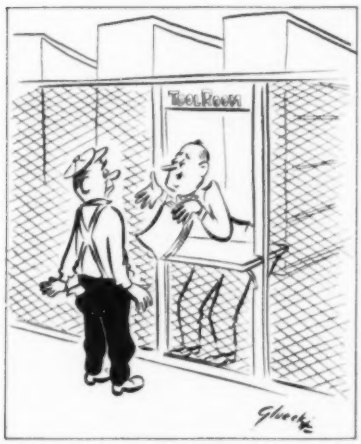
one was leaking. An outside contractor was engaged to repair the leak. Due to the intense heat, it was only possible for two men to work ten minutes, so three gangs were required. All work had to be done at night at overtime rates and the charge was $500. Subsequently we checked them all and discovered there were 18 more leaking, so I personally took over and repaired them with our own plant personnel at a small fraction of the cost by an outside contractor. Incidentally, it took a year off my life . . .

In all fairness, at this point, I must emphasize that it was in no way the fault of the expansion joints, but carelessness and indifference of the men who installed them. In one case we found the shipping bolts had not been removed and for the most part we found defective flanges and defective gaskets.

My company is now building another job and you can guess I bucked for fabricated piping to avoid a repetition of this trouble. It was agreed costs were not too far apart except for the underground. The concrete pits had to be twice the size and this doubled the cost. We compromised by installing corrugated expansion joints in the underground pits and fabricated pipe in the buildings. However, I wish it were the other way around.

The prices listed were obtained in 1950, so you can expect to pay 50 per cent more.

Fresh Meadows 65, New York — WALTER J. STEINERT



"Now wouldn't it be simpler to go buy one of your very own?"

Answer No. 509

How Repair This Leaking Pipeline?

Prevent Contact, Says Hunter

I WOULD think that using a larger-size pipe as a sleeve through the cement would protect the steam and condensate line from contact with the cement. In answer to the second part, I would completely remove the pitted section and replace with new pipe.

Waterford, New York — F. J. HUNTER

Pipe Sleeve Through Concrete, Says Wayne

HMP STATES the lines are approximately 2,000 ft long and were installed about seven years ago. He does not give the operating pressure and temperature of the systems or any information regarding the configuration of the piping runs, such as length of straight pipe, number and type of bends, spacing between anchors, and so on. However, the following suggestions are offered as a guide:

A high temperature pipeline will expand, the magnitude depending upon the operating temperature and length of runs. If bends, offsets or expansion joints are located properly, the thrusts resulting from pipe expansion can be reduced to within acceptable limits. A sleeve cast in the concrete will serve as a slip joint and permit the high temperature pipe to move axially and radially without rubbing against the concrete which may cause cracking and abrasion along the pipe wall. The sleeve is anchored in the concrete and is one pipe size larger than the steam or condensate pipe.

HMP does not state if the condensate makeup is pretreated before it enters the boiler. Since liberated oxygen, solids concentrations and pH have a definite influence on corrosion of ferrous metals, the following suggestions are given for the guidance of HMP.

If the steam temperature is reasonably high, liberation of oxygen will result which may lead to corrosion. Since the solubility of oxygen in water varies inversely as the temperature, the higher the water temperature the greater this tendency. High oxygen release has a detrimental effect on all ferrous materials.

If the boiler makeup has a high solids concentration and an evaporator is not used to keep the solids content within the acceptable limits, pipe corrosion may result. The American Boiler Manufacturers Association Standards for maximum solids concentration are as follows:

Boiler Pressure—psig	Solids Concentration—ppm
0-300	Not over 3500
301-450	Not over 3000
451-600	Not over 2500
601-750	Not over 2000
751-900	Not over 1500
901-1000	Not over 1250
1001-1500	Not over 1000

If the water is on the acid side (low pH), corrosion can result. It is suggested HMP have samples of the steam and condensate tested for oxygen content, solids concentration and pH. A competent water chemist can make these tests and recommend proper water treatment.

From the information submitted by HMP, I do not believe electrolysis is present. The electro potential difference between water and silicate which is the principal constituent of concrete is not great enough to cause this reaction.

Editor's Note: While this statement is generally true, it should be noted that Mr. Wayne qualified it by stating "From the information submitted by HMP" . . . For a discussion on the effects of electrolysis in concrete structures (reinforced), refer to Marks' Mechanical Engineers' Handbook.

A suggested means of protecting the pipe against excessive external moisture is to wrap the exterior with a bitumastic compound where the pipe is encased by the concrete. This will serve as a barrier to keep the moisture of the concrete from coming in contact with the steel pipe. The moisture content of the concrete will be greatest when it is poured and will decrease as the concrete ages.

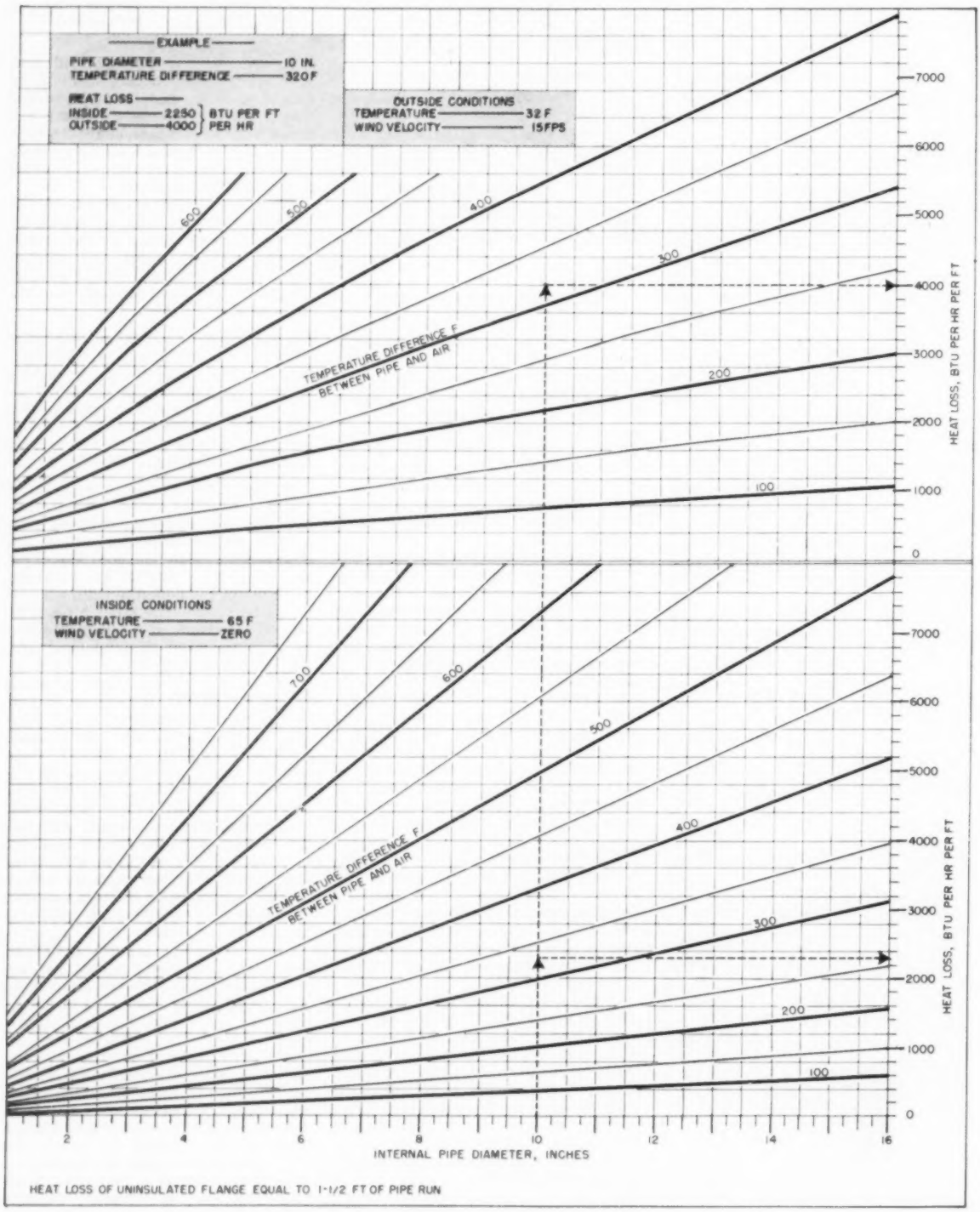
In answer to the first question raised by HMP, insulation should not be used to support the pipe. Insulating materials do not possess sufficient strength to permit their use for this type of service. An 85 per cent magnesia will crumble and powder when little force is applied. Other insulating materials will not fail in this manner, but are resilient enough to lack suitable structural properties. Outdoor pipe coverings are not capable of taking external forces and therefore pipe supports should be provided.

Answering the second question, iron cement or chemical patches are not suitable for surfaces subject to high temperature. Since the temperatures are not given, I suggest HMP consult with the manufacturers of these products and determine if the materials offered are suitable for the conditions of operation. Generally, cement and patches should be avoided where constant high temperature surfaces are involved. Removing the high spots on the pipe or building up the pipe is not recommended. Usually it is cheaper to replace the corroded pipe and be assured of a satisfactory installation.

Brooklyn, N. Y. — H. B. WAYNE

Curves for Figuring Heat Losses from Uninsulated Pipelines

Dislike all the detail involved in calculating losses from uninsulated pipelines? This chart gives direct readings for indoor or outdoor lines, from 1½ to 16 in. in diameter, in typical atmospheric conditions


EXAMPLE
PIPE DIAMETER — 10 IN.
TEMPERATURE DIFFERENCE — 320 F
HEAT LOSS
INSIDE — 2250 } BTU PER FT
OUTSIDE — 4000 } PER HR
OUTSIDE CONDITIONS
TEMPERATURE — 32 F
WIND VELOCITY — 15 FPS
INSIDE CONDITIONS
TEMPERATURE — 65 F
WIND VELOCITY — ZERO
TEMPERATURE DIFFERENCE F BETWEEN PIPE AND AIR
HEAT LOSS, BTU PER HR PER FT
INTERNAL PIPE DIAMETER, INCHES
HEAT LOSS OF UNINSULATED FLANGE EQUAL TO 1-1/2 FT OF PIPE RUN

Courtesy *The Steam Engineer*, London, England. Copyright in Great Britain by W. Goldstern.

Wind to Vacuum to Power

By JOHN GRINDROD

Norfolk, England

WHETHER OR NOT wind power could be used to generate electricity for the national grid system has been exercising the minds of engineers of the British Electricity Authority of recent years.

As a practical step toward an answer, the Authority invited bids in April 1949 for the design, manufacture, testing and setting to work of one wind-driven electric generator of 100-kw capacity. The sequel to this has been the construction of an anemo-electric generator which is the first depression-type plant of its size and kind to be erected in the world. This machine, whose propeller sweeps a circle 80 ft in diameter, is being given preliminary trials this summer at a site near St. Albans, Herts.

At the time bids were invited by the B.E.A., engineers of Enfield Cables Ltd. were studying the economics of wind power as a source of heat for horticultural purposes. They had in mind the construction of a small plant which could be used by growers in suitable remote places. One of the places for which such "packaged" equipment was thought very suitable was, for instance, the Channel Islands, which specialize in early vegetables and fruit for the British market. Here, fuel is expensive but there is a good wind availability. Such equipment would have included soil-heating cables and other of the company's standard products.

These plans were, however, to be shelved for the time being when the interest of the B.E.A. in wind power became known. Enfield felt that, if they could secure the order from this source for the proposed wind-driven generator and bring the plant to a successful point of operation, their reputation in this field would be enhanced considerably. From this the launching of any smaller machines on the lines previously contemplated would benefit greatly.

Upon what type of machine to concentrate was the problem then confronting the firm. It seemed fairly obvious that nothing greatly worthwhile would be gained from planning along orthodox lines. Such machines, propeller-driven through a speed-up gear box of high ratio, were in use in Denmark and one was to be tested in the north of Scotland. In a number of European countries unorthodox schemes were being demonstrated and Enfield engineers finally decided to work on the "depression" principle which then was being tested on a small scale by Andreau of France.

This system, making use of the in-rush of air through an air turbine, was found to have both advantages and disadvantages; the disadvantages, however, appeared to be in the minority. Its conversion efficiency was slightly lower than that achieved by orthodox plants of the same size and the cost of development would be greater. On the other hand, it had considerable physical and mechanical advantages. This was the case even in a plant of 100-kw capacity. As the machines grew larger, as would be likely if they were successful, the advantages would increase progressively in value.

By the end of 1949 Enfield Cables Ltd. were able to offer their machine to the B.E.A., whose acceptance of it was made public at the Plenary Meeting of the World Power Conference of 1950.

Co-operating with the Enfield engineers during this early period were de Havilland Propellers Ltd. and the English Electric Co., Ltd. The former company designed the machine from first principles and it has been constructed largely at their works. The latter company has been responsible for the whole of the electrical equipment except for cables which are "Enfield's." The Redheugh Iron and Steel Company built the tower on Tyneside to de Havilland design and Butters Bros. made the lifting gear.

Eventually expected to be built on foundations consisting of a central base of reinforced concrete with 12 anchors on a pitch circle diameter of 96 ft concreted into rock, the hollow tower is of stressed steel plate and girder construction. It is 100 ft from the top surface of the foundation to the axis of the propeller. Circular in section the tower decreases in diameter from 9 ft at the base to 3 ft 6 in. where it enters the hub structure. The control gear is housed in the base. Within the zone of the propeller disc the upper section is screened with a light alloy fairing of aerofoil

(*Continued on page 111*)

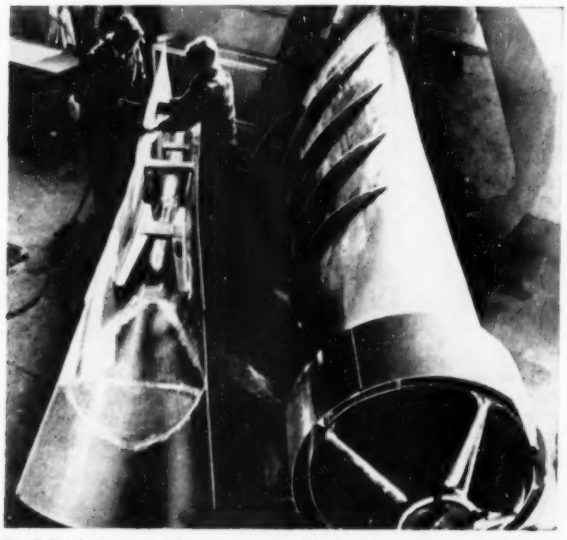


Fig. 1. Blade is circular where it enters the hub, but changes to an airfoil section toward the tip. Blades are fabricated hollow to allow for centrifugal air flow

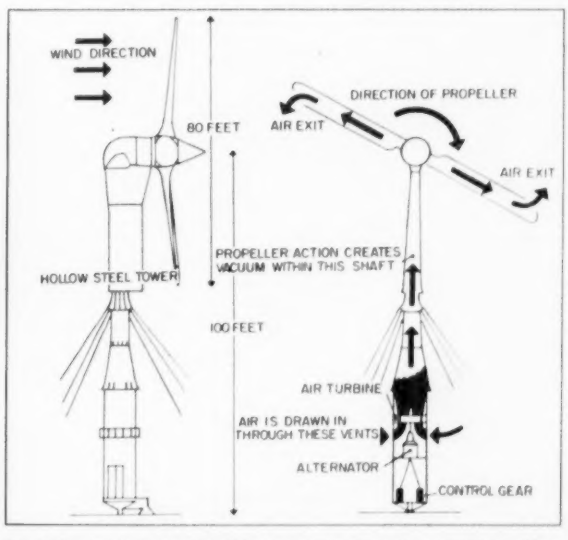


Fig. 2. "Depression" principle of design permits a trim tower structure with no heavy equipment on top. Turbine and generator both are located at the base

Let Paint Colors Identify Materials

By L. G. JONES

Here is how proper use of paint colors can aid in identifying operating controls, save time, prevent use of the wrong materials or operating the wrong valve, save maintenance labor, materials

NOT ONLY does the color of the coating on materials provide a simple means of controlling their temperature by virtue of the power of reflection or absorption of heat, but color forms an excellent means of identification.

The psychological values of colors have become recognized by the U. S. Air Force. In this age of supersonic speeds and high altitude flight, moments are what minutes used to be. Minor control errors magnify rapidly into major ones. Human (or pilot) error is a primary or contributing factor to 60 per cent of all aircraft accidents.[1]

Work is under way to improve identification, not only instantly, but automatically, in order to eliminate any need for search by sight or touch. Levers may be shaped to fit ideas, control knobs for the plane flaps are shaped like airfoils; miniature wheels replace conventional round knobs on landing gear controls; and other means of associating the "feel" or "touch" with the ultimate objects controlled.

Color for Function

Facing drab monotonous colors, with rows of identical instruments, and a sameness of everything, for many hours in a small cockpit greatly reduces alertness and capabilities of individuals. Colors are to be given both esthetic and functional values to give cheer, to improve morale, to prevent depressive tiredness, and to accomplish the mission.

Instrument shapes and patterns are adjusted so that one glance catches out of line readings on instantly recognized functions. Warning signs are related to concepts so that trouble signals easily can be absorbed mentally for quick interpretation and immediate appropriate action.

From among these psychological developments for identification, paint colors have become the most important. Paint is applicable universally to any shape or surface, anywhere. The power plant has become a beneficiary of this development, as much as the airplane, the battleship, the industrial plant.

Standard Color Codes

The American Standards Association has officially adopted a "systematic plan[2] employing color and other kinds of marking based upon fundamental principles". There is no doubt that a standard code of color marking of materials for their identification would be of great help to operators who have learned the code. Such markings save:

1. Much time in referring to maps, blueprints, inventory stock catalogs, or other records that list the items concerned.

2. Costly errors resulting from using the wrong steel, opening the wrong valve, or improperly identifying materials or equipment in the plant.

3. Tedious training of personnel in the location, selection and handling of materials and equipment from among a maze of piping or bins.

4. Inter-plant misunderstandings; personnel could go from one plant to others without retraining, already knowing the piping, valves, and materials that are used for common purposes.

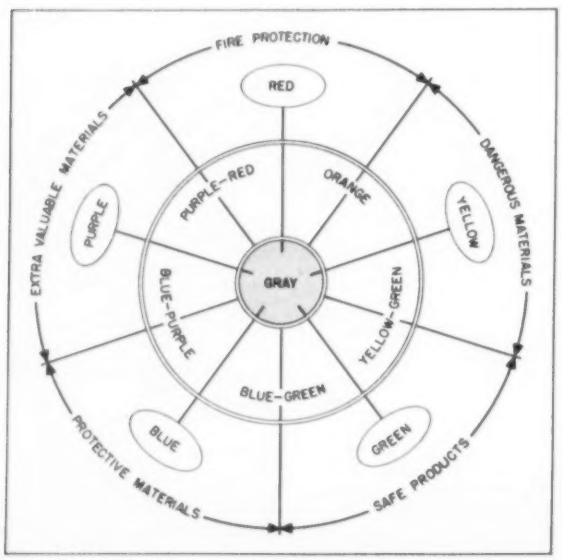
Principal requirements in the use of paints for identification purposes are distinguishability, simplicity, flexibility and rationality; ASA A-13 also lists inclusiveness and practicality. Term "rationality" refers to association of colors with normal conceptions or ideas built up over many years: fire when we see RED, safety when we see GREEN and so on.

Basic classification has been set up by ASA in terms of five fundamental colors:

Class of material	Code letter	Color
Fire protection equipment	F	Red
Dangerous materials	D	Yellow
Safe materials	S	Green
Materials that provide protection	P	Bright blue
Extra valuable materials	V	Deep purple

In the term "flexibility" one can visualize the range of blends and variations that can be made up within each of the above classifications. Where a large number of materials would fall under one classification, a method of stripes and combinations of colors has been developed to cover a large group of items. This is illustrated best by means of a containment circle arranged with the basic colors enumerated above as the significant points of the "compass" that allows for many blends and variations within the range of each classification, as given in the illustration at the left.

Use of complementary colors as the base of each group or classification permits significant shading for pipe lines for fluids that lie between and are related to the basic groups. Strips or configurations that approach the base can indicate the degree of



Circular arrangement of basic solar spectrum colors in a natural order, showing five regions of basic colors forming background for use of shades of these colors for materials within these regions. From American Standards Association Bulletin ASA A-13-1928

[1] Herbert A. Shaw, Dayton (Ohio) *Daily News*, July 29, 1952.

[2] American Standards Association Circular A-13-1928 (reaffirmed in 1947).

nearness in composition or usage to the next related basic color.

Each industry probably has developed its own particular color code. It is natural that chemical plants with a multitude of piping containing many fluids peculiar to their own products would vary greatly from the more simple requirements of a steam boiler plant.

Color for Piping Systems

Standardized color schemes are particularly desirable for the piping of a plant. All pipes and valves look alike on the outside. We often can identify their content by their relative size, type of connections, etc., but these methods are not sufficiently reliable for safety. Gas lines usually are larger than compressed air, but water and steam lines may be large because of the large volumes of water and steam normally used. Gas lines use malleable fittings, water lines employ cast iron fittings, and steam lines usually are flanged in joints. Steam lines are covered with heat-preserving insulation, but water lines may be covered in order to reduce condensation of moisture. The experienced operator learns to recognize the content of piping by observing these important installation details which may appear insignificant to a trainee.

For power house piping, Kent's Mechanical Engineers Handbook quotes some ASME committee recommendations for color coatings on valves, flanges and fittings only, as listed in Table I.

Proposed color code of the Pulp and Paper Industry (1926) contained recommendations on items similar to those listed for the Power Plant Industry in Table I.

Table I. Summary of ASME committee recommendations for color identification code for use in power house piping. Paints are to be applied on valves, flanges and fittings only. Many plants use modifications

Division of Power Plant	Character of Fluid	Color Proposed	Corresponding Class	ASA Basic Code Color
Steam	High pressure	white	dangerous	yellow
	Exhaust	buff	dangerous	yellow
Water	Fresh, low pressure	blue	safe	green
	Boiler feed lines	blue and white	dangerous	yellow
	Salt water	green	safe	green
Oil	Delivery and discharge (lubricating)	brass or bronze-yellow	valuable	purple
	Fuel oil	black	valuable	purple
Other fluids	Compressed air	gray	dangerous	yellow
	Gas	aluminum	dangerous	yellow
	Refrigeration	white and green	dangerous	yellow
Electric lines	Feeders	black and red	dangerous	yellow

Note:—Interpretation of corresponding ASA basic code colors is by the author.

Table II. Code for steel and alloys Bureau of Standards Simplified Practice Recommendations R-166-37

General Classification of Steel	S.A.E. Number	Code Color
Plain carbon steels	1010—1015	white
	1020—1020X	brown
	1025—1025X	red
	1030—1035	blue
	1040—1040X	green
	1045—1045X	orange
	1050	bronze
	1095	aluminum
Free cutting steels	1112 to 1340	yellow basic color, with various accompanying colors for higher numbers.
Manganese steels	T1330 to T1350	orange base with accompanying green and red for higher numbers.
Nickel chromium steels	3115 to 3415	basic color blue, with other accompanying colors.
	3125	pink
	3312 to 3435	orange base with other accompanying colors.
Nickel steels	2015 to 2515	red basic color with other accompanying colors.
Molybdenum steels	4130 to 4820	basic color green with other accompanying colors.
Chromium steels	5120 to 5210	basic color black with other accompanying colors.
Chrome-vanadium steels	6115 to 6195	basic color white with other accompanying colors.
Tungsten steels	7136 to 7260	basic color brown with other accompanying colors.
Silicon-manganese steels	9255 to 9260	bronze and aluminum colors.

Note: The accompanying colors for the different analyses within each group are white, brown, blue, green, etc., which supply a variation of the basic color common to all components of each group, with the exceptions that are listed in detail in the tabulation, in the carbon and nickel-chromium steels. Derived from *Metal Progress*, magazine of ASM.

Color for Metals and Alloys

Fabrication of a part from the wrong type of metal drawn from warehouse stock has not infrequently been the cause of a lot of trouble. It is practically impossible to identify the character or composition of a piece of steel from its looks. Ability to identify a piece of steel even by the sparks it makes on an emery wheel has become a lost art. Today's many alloys render spark tests for identification hazardous in selecting a bar of stock.

Most alloy warehouses paint the ends of their stocks of steel with specific colors of identification based on codes similar to those for plant piping. There is more danger of mixing up steels at the using industrial plant than at the steel warehouse. The steel producer and warehousing sales agency recognize their responsibilities to the user in supplying improper steels on any specific purchase order.

The industrial plant stockkeeper may not understand the relative properties of different bars of steel, especially where this steel serves for limited maintenance purposes only. The production plant that uses large quantities of each type of steel, in screw machines or other continuously operating equipment, rarely misplaces steel in large storage quantities. Hence the color codes would be of greater importance to the power plant or similar industry where steel or metal stocks are truly a minor item.

ASM Code for Steel

The American Society for Metals has published a rather comprehensive color code for marking metals and alloys. Some examples are shown in Table II for steels.

The plain carbon steels are given in greater detail because each carbon range is given a different solid color. But the full color code for all the subdivisions of each group is available from the American Society for Metals. This also is true of the tabulation on non-ferrous metals. Many non-ferrous metals can be identified by experienced men by the natural color of the alloys, such as brass, bronze, aluminum, etc. However, there are so many alloys under each metallic color today that such identification is very risky. A little paint does a sure job for the average stockkeeper.

Usually the code colors are painted on the ends of the bars so that the stockkeeper can select the bar from among a mixed stock in the bin without disturbing the pile, by examining the exposed ends of the bars. Where stripes and secondary colors are involved, the base color on the ends of the bars provides the first clue. The stripes along the length of the bar complete the identification.

Post Color Codes

Printed color code sheets must be posted not only in the stock room but in the machine shop and other locations of use as well, in order that errors can be caught before the finished part is completed and installed. Piping codes should be posted at all operating stations where they can help operating personnel, as well as in engineering sections where layouts are made. Of course all color codes should be posted in maintenance shops, for plumbers, machinists, repair men, and so on, for their

(Continued on page 113)

Elrama Uses Flywheel-Motor-Driven Exciters

These exciters reduce turbine length, improve commutation, and increase reliability. Behaviour under fault conditions described

By

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FIRST three generating units at the Duquesne Light Co.'s new Elrama Station have a main generator and a station generator on a common shaft. The method of providing excitation for these direct-connected generators was studied thoroughly, as it was desirable to limit the length of the units, for economy in station structure, and to improve their mechanical design. The selection of motor-driven main exciters was based on several factors.

Developments in the design of turbine-generator units have resulted in more reliable generators, turbines, boilers, and auxiliaries. This increased reliability has lengthened the time between shutdowns for maintenance. Also, there has been a continual increase in the size of turbine generators requiring a corresponding increase in exciter ratings.

The design of 3600-rpm exciters with satisfactory commutation becomes more difficult in the larger sizes. Thus, the designer is faced with the problem of building exciters with increased reliability in larger and larger ratings while satisfactory commutation becomes correspondingly more difficult. When the exciter rating is 300 kw or larger, a speed lower than 3600 rpm allows the designer more freedom and makes it possible to approach more nearly the ideal of having no shutdowns for major exciter maintenance between the periodic shutdowns necessary for maintenance on the remainder of the unit.

Reduced exciter speed can be obtained by removing the exciter from the main generator shaft and driving it with a motor at a more desirable speed or by gearing the exciter to the generator shaft. In addition to reduced speed, the motor-driven exciter has these other advantages:

Special Design Features

1. If a spare excitation source is available, maintenance of the exciter can be accomplished without shutting down the main turbine-generator unit except during the unit's scheduled outages.

2. Removal of the exciter from the main shaft shortens the unit and simplifies the design of the generator. It also makes it possible to place the exciter in a more convenient or less expensive location.

3. Removal of the exciter from the main generator foundation results in reduced vibration and reduced commutation problems.

Primary objection to the use of standard m-g sets for providing excitation is the possibility of losing excitation during system low-voltage conditions. At Elrama Station the motor-driven exciters ordinarily will be supplied from direct-connected station generators. They can be supplied from the system through auxiliary transformers, with either manual or automatic transfer.

The station generator and auxiliary transformer are not paralleled, which results in an open transfer. For this reason the voltage applied to the terminals of the driving motors may be essentially zero during transfer or in the case of system faults and subsequent breaker operations. The motors will slow down during these periods of low voltage, thus reducing the exciter voltage and response. Since it is essential that the motor-driven exciters be equivalent to direct-connected exciters during any operating condition, they must be of special design to guarantee equivalent performance at the minimum speed reached.

Reduction in speed during low-voltage conditions can be limited by the use of a flywheel. However, it is impractical to provide a flywheel of sufficient inertia to limit the drop in speed to a negligible value. The practical solution to this problem is to add sufficient inertia to the set by means of a flywheel to limit the speed reduction to a reasonable value, and to design the exciter to be equivalent at the minimum speed to a direct-connected exciter. The usual procedure is to add sufficient inertia to hold the minimum speed during any abnormal operating condition to not less than 90 per cent of normal speed.

Exciter Response Speed

Since the exciter response and ceiling voltage decrease as the exciter slows down, it becomes necessary to design a machine with a speed of response and ceiling voltage higher than normal at rated speed. Since the speed and decelerating forces are dependent upon both the inertia constant of the set and the exciter characteristics, the calculations to determine whether a motor-driven

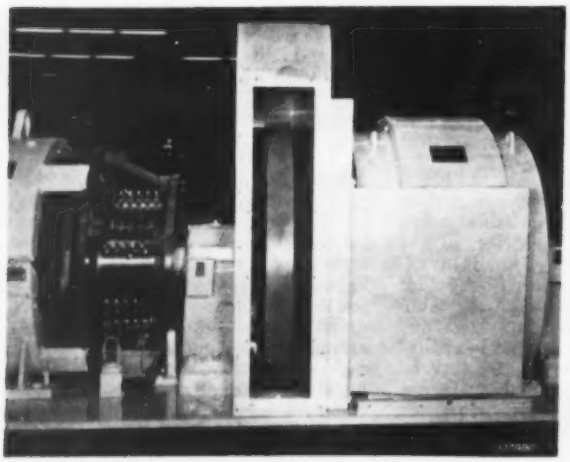


Fig. 1. Close-up of main exciter and flywheel with attached ventilating fan

Fig. 2. View of the main and spare exciter sets in their ventilated housings

exciter with given characteristics will provide reliable excitation under various system operating conditions are quite complex. The required calculations are outlined in "Selection of Characteristics for Turbine-Generator Motor-Driven Exciters," AIEE Technical Paper 52–33.

In addition to the flywheel and special exciter characteristics, the motor of the m-g set also must be given special consideration. The driving motor must be capable of providing positive acceleration and restoring normal exciter speed after it is transferred to an alternate source or after voltage is restored following a low-voltage condition. The motors for this application normally are designed with at least 500 per cent pull-out torque. However, the speed-torque characteristic of the motor should be checked to insure that the torque will be adequate at the speed and voltage prevailing when its power supply is restored. The exciter output during system faults may be three or four times rated kilowatts or even higher.

The high value of exciter output is caused by the increased alternator field current and by the increased exciter voltage due to regulator action. At this same time, the voltage of the alternate source to which the motor is transferred may be low due to the regulation with suddenly-applied load. Finally, the motor may have slowed so much that it cannot develop its peak torque.

Elrama Exciter Details

Simplified one-line diagram of the first two units at Elrama Station is shown in Fig. 3. The third unit will be completed in 1954. The units have a 30-pound hydrogen rating of 125,000 kva and 80 per cent power factor. The 300-kw, 375-volt exciters have a speed of response of at least 0.5 at 90 per cent speed and a ceiling voltage of 500 volts at rated speed. The 450 horsepower driving motors have a pull-out torque of 550 per cent. Since pull-out normally occurs at a very low value of slip on motors of this size, it was necessary to design the motors with increased slip at pull-out to insure adequate torque at 90 per cent speed. Flywheels were added to the exciter sets to increase the inertia constant to ten. This is about three times the inertia constant of the m-g set without a flywheel.

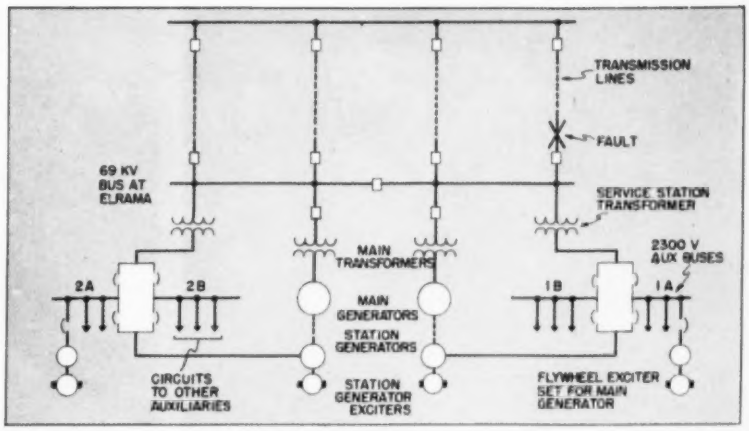


Fig. 3. Simplified single-line diagram of first two units at Elrama Station for analysis of fault conditions

Fault Conditions

Characteristics required in a motor-driven exciter depend on the system and the types of faults that are considered. In the unit system at Elrama Station the machine will be disconnected from the system for bus faults and faults on the generator side of generator breaker.

There is no need to consider any fault that results in the separation of the machine from the system since excitation is of no importance in this case. In this particular system, therefore, the most severe fault to be considered is a three-phase fault on the line side of one of the line circuit breakers.

If the breaker on the faulted line failed to interrupt the short circuit, the back-up relaying would clear the bus section in 32 cycles after the initiation of the fault. The generator on the faulted section, of course, would be isolated from the system, but the generator on the other bus section would continue in operation if it did not lose excitation or pull out of step. Studies on the A-C Network Calculator indicated that a three-phase fault this near the generator lasting 32 cycles would cause a very marginal stability condition. Therefore, an exciter that is still at 90 per cent normal speed and providing ceiling excitation after 30 cycles is a conservative solution to the problem. Extensive calculations showed that the motor-exciter-flywheel combination is capable of this.

Performance and Stability

On the other hand, it is not economical to provide an excitation scheme that would exceed this performance greatly because instability of the power system would make the excess performance unnecessary. The system stability is of particular importance for the exciter set. Exciter performance that is in balance with inherent system stability gives the most economical solution.

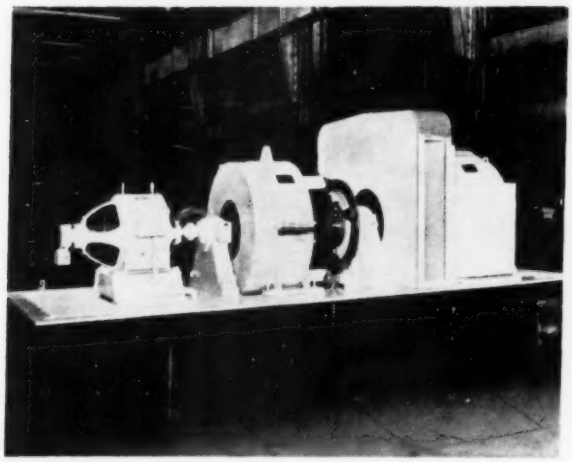


Fig. 4. Exciter set with housing removed. Rototrol pilot exciter is on left

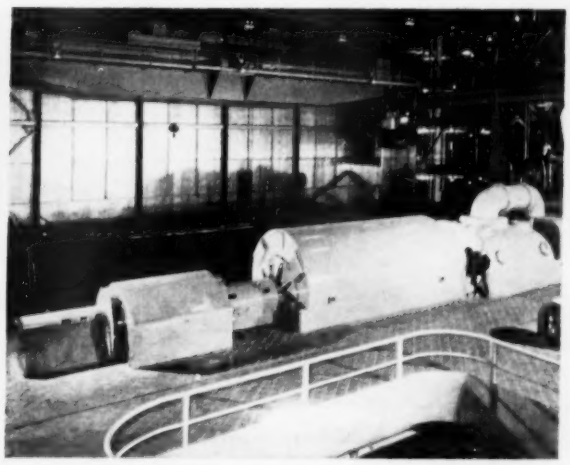
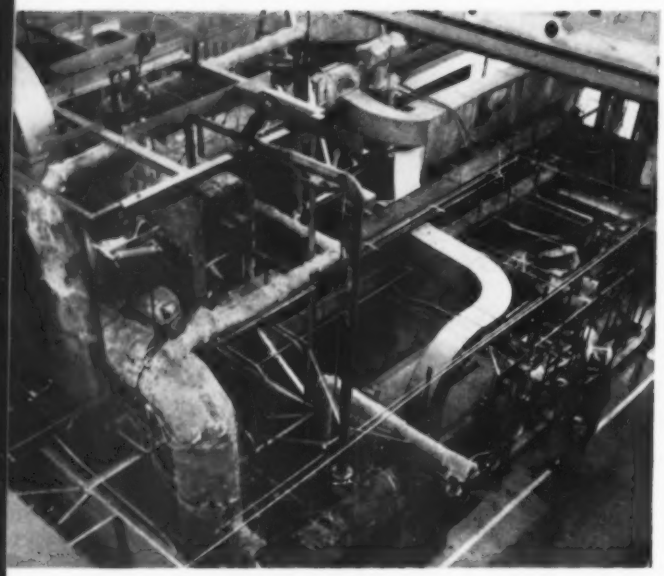


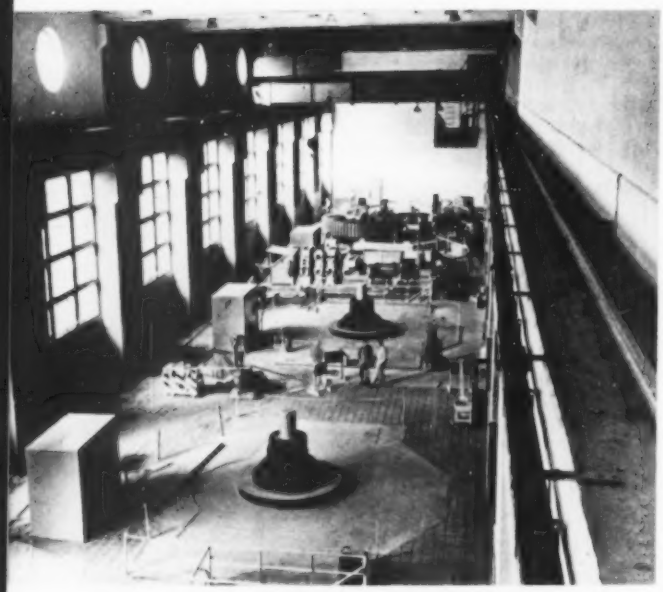
Fig. 5. One of Elrama's 90,000 kw units. Station auxiliary generator at left



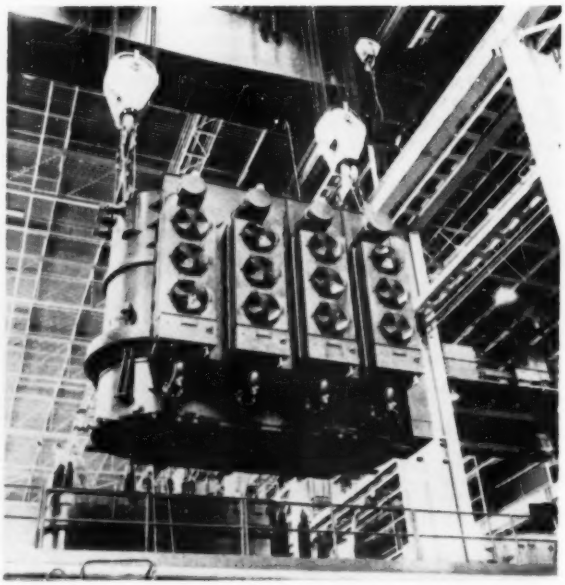
Liquid sodium at temperatures ranging from 580 to 1000 F is pumped and metered electromagnetically in this experimental installation at the Knolls Atomic Power Laboratory. Magnetic flow meter measures to 2% accuracy

Now it's glass-lined smoke stacks! A. O. Smith built and erected this first glass-lined smoke stack in industrial history after testing samples of the material in stack gases. This section weighs three tons, is 44 ft long and 6 ft in diameter

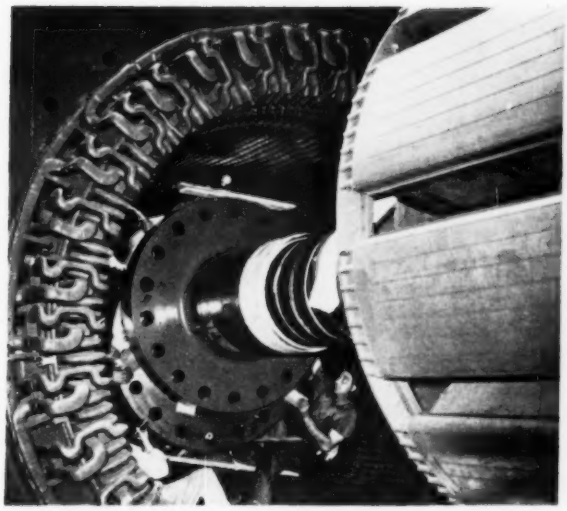
Power Engineering



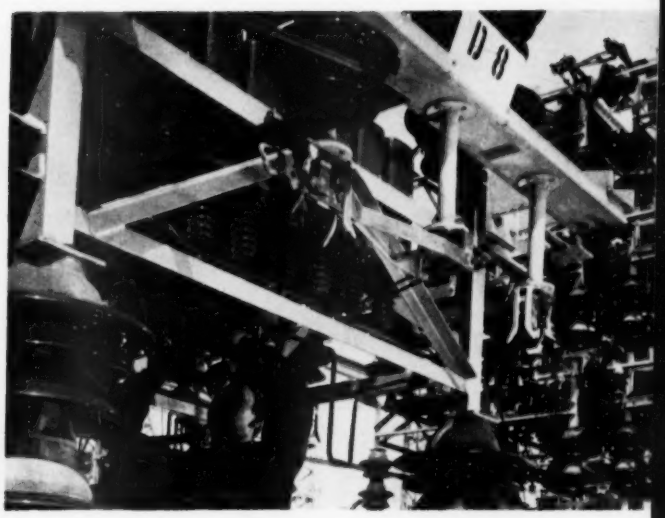
Work is nearly complete on the fourth and last hydraulic turbine generator to be installed in the Fort Gibson project. All four units are rated at 17,000 hp (100 rpm) at their design head of 59 ft, were built by Baldwin-Lima-Hamilton



Enough power to serve half of the state of Arkansas will be handled by two of these new 140-ton transformers when installed. Built by G.E.'s Pittsfield, Mass., plant, they will go to the three new generating stations of the AP & L

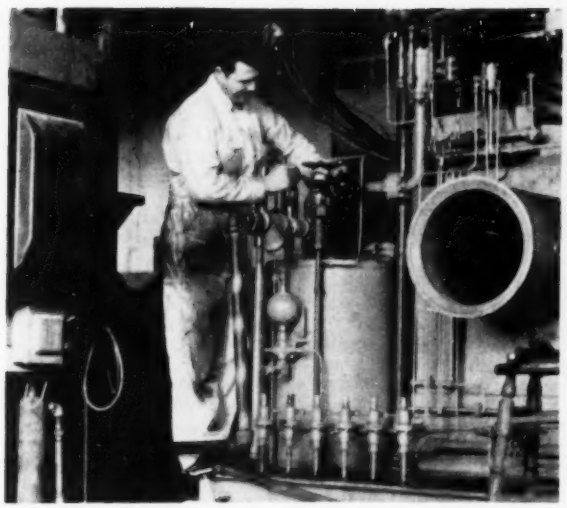


Arnold Engineering Development Center, Tullahoma, Tenn., has installed an 83,000-hp synchronous motor as the "first major step" in assembly of the 216,000-hp drive required for its new transonic and supersonic wind tunnel

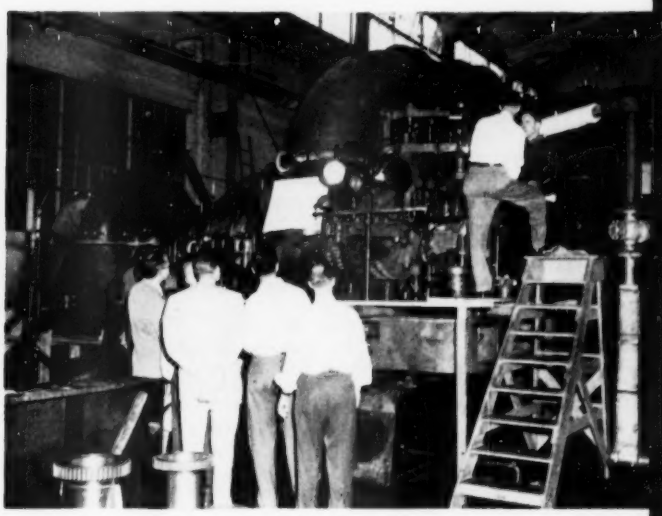


Askarel-filled capacitors were installed purposely upside down at G. E.'s Switchgear Development Laboratory in Philadelphia. This was done to allow for quick changing of test connections. Capacitors work as well either way

Lots of magnetic attraction is the claim for this — pulley. Dis Dings is supposed to be the largest electromagnetic pulley in existence at this time (60 in. diam)



Picture of a man preventing seizure and galling of boiler equipment fittings and bolts. A concentrated dispersion of colloidal graphite in oil is painted on nuts, bolts and flanges which are subjected to high operating heat and pressure



Community leaders turned out for De Laval's open house tour of steam turbines, speed reducers and centrifugal compressors which they produce for a world market. Trenton citizens showed considerable interest in the equipment

Fig. 1. Taking boiler water sample, using the type of cooling coil illustrated in Fig. 5. This arrangement is one of the most widely used in present-day industry

Sample Your Boiler Water Effectively

Most power plants have testing programs for controlling their water conditioning, but control is often ineffective because samples are poor. Here's how samples should be taken to get good results

By D. V. De GEER

Water Conditioning Specialist, Allis-Chalmers Mfg. Co.

SAMPLES for proper control of water conditions in a power house will vary widely from plant to plant. A small manufacturing plant with a steady load may require occasional boiler water and feedwater samples only. Another power house with a variable water supply and steam demand may find it necessary to sample the raw water, feedwater and boiler water. Plants using external softening equipment and a deaerator may find it necessary to sample the softener influent for control of its operation, the feedwater for deaerator efficiency, in addition to the usual boiler samples.

Steam and condensate sampling often are necessary for control of carryover and corrosion. The makeup and circulating water in a cooling tower system also will require sampling for control of the corrosion or scaling potential, and the cycles of concentration.

Plants with small heating boilers may need to sample only once each day, while a high pressure, high makeup, variable load industrial type power house may find it necessary to take samples from various parts of the cycle as often as once each hour.

Where the treatment is fed continuously to a boiler which is blown down continuously, the actual time of sampling is not too important. However, to determine the results under the most difficult operating conditions, sampling during periods of high load generally will prove advisable.

Where to Sample

Where intermittent blowdown or treatment procedures are used, sampling before the blowdown or the addition of treatment will provide the soundest basis for control of these items. Samples of steam and condensate should be taken at times of highest loads when the possibility of contamination is greatest. Accepted practice for sampling water from a cooling tower is once each eight hour shift minimum. Since continuous feed of treatment and "bleed", or blowdown, is usual, actual time of sampling each shift is unimportant.

A sample which does not represent actual water in system is useless.

Results from several locations should be compared to select the final sampling point. In a boiler, the most satisfactory location is the continuous blowdown line if one is installed. The water level gauge glass fittings often provide a satisfactory sample if the feedwater does not enter too close to the gauge glass openings. Any other locations for obtaining a boiler water sample may be considered if representative results can be obtained.

It is generally advisable to sample feedwater after the boiler feed pump to determine the amount of oxygen actually entering the boiler. Sampling a condensate in which a corrosion preventive is being used will be useless if these contaminants are present in the sample. In addition, if quench water is used in a condensate return pump, the condensate must be sampled before it reaches the pump.

Provision should be made for sampling individual condensate return lines before they are combined, so that contamination can be traced to its source. Where oil removal filters are installed, condensate must be drawn before and after the filters to

determine the effectiveness of removal.

Steam should be sampled by means of a sampling nozzle located after a run of straight pipe whose length is equal to at least 10 diameters. The preferred location is in a vertical pipe with a downward flow of steam.

Cooling tower circulating water should be sampled at the circulating pump discharge, and the raw water make-up where it enters the basin but before the treatment is added.

Taking the Sample

After selecting the point of sampling, it is necessary to apply the proper method to assure a truly representative sample. The sample line must be blown down thoroughly to remove condensate, stagnant water, sludge, or scale. Pyrex containers are most satisfactory for collecting samples. They must be kept clean and rinsed thoroughly with the water to be sampled before they are filled. Samples should either be tested immediately or be protected from contamination.

Special devices and procedures for sampling are necessary for tests such as oxygen and excess sulfite. Instructions for operating the devices usually describe the procedure clearly.

Steam samples should be drawn through nozzles of the type shown in Fig. 3. The ports must face upstream and be spaced and sized to withdraw quantities of steam that are proportional to the area of the section each port represents. The nozzle should be designed for a minimum pressure drop and should permit the steam to enter the nozzle at the same velocity as that existing in the pipe line. The sampling rate should be adjusted until it is the same fraction of the steam flow as the total port area is of the steam line inside area. Condensers or cooling coils of corrosion resistant material are generally required for steam sampling.

A new steam sampling connection should be purged by steam flow for 24 hours before the sample is taken. Routine practice will require a flow of one hour before sampling.

Boiler Water Flashing

Fig. 4 illustrates the flashing of boiler water when allowed to cool in an open container from various boiler pressures to atmospheric pressure. The same chart also shows the percentage increase in total dissolved solids upon flashing from the various boiler pressures. It will be seen that the higher the pressure, the more inaccurate the results of the tests will be if the sample is not cooled before or while being drawn. Figs. 2 and 5 show two types of cooling coils that have been used successfully for the sampling of boiler water and steam.

In low pressure plants, flashed samples sometimes are used but it should be remembered that they are not really representative samples.

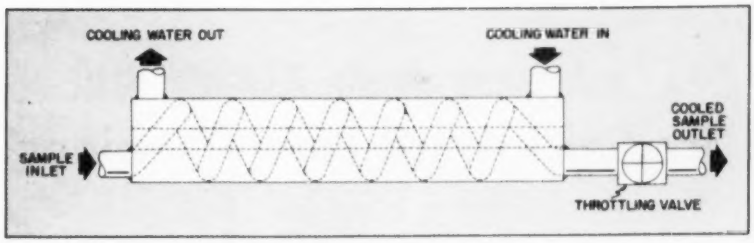


Fig. 2. Shows one type of cooling coil used for sampling water and steam as explained in this article

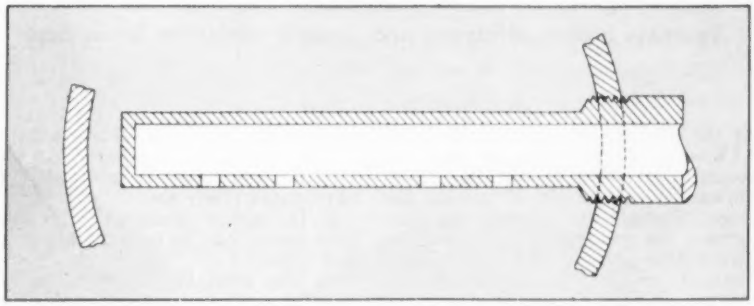


Fig. 3. Steam sample nozzle. 4 ports for a pipe 6 in. I. D. or less; 6 ports for a pipe 6 to 12 in. diam

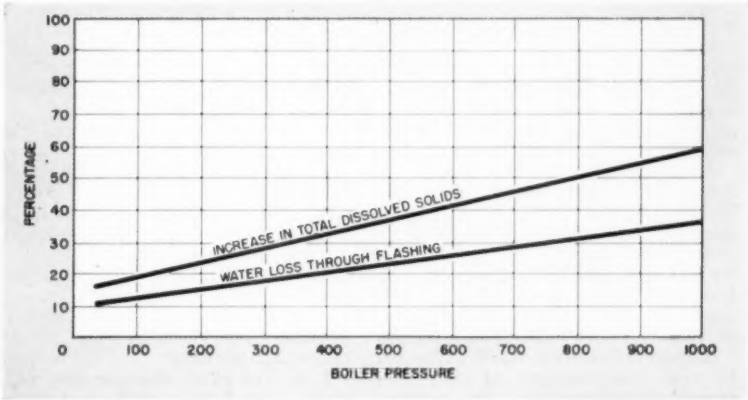


Fig. 4. Effect of allowing boiler water samples to flash from boiler pressure to atmospheric pressure

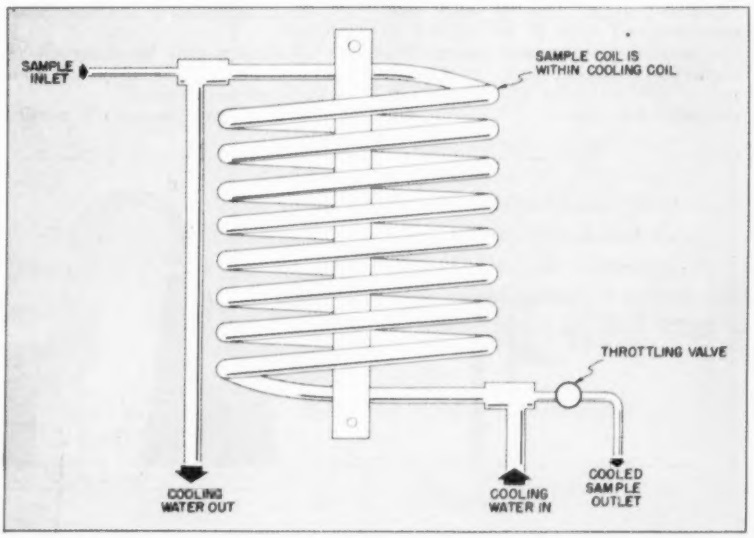


Fig. 5. Diagram showing a widely used type of cooling coil for taking steam and boiler water samples

Radial Inward-Flow Turbines

Power men are considering the inward-flow principle of turbine design as answer to limitations of the axial-flow type. It promises higher efficiency and specific output at lower cost

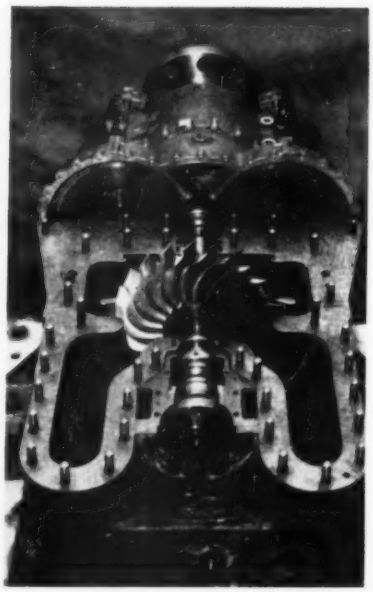


Fig. 1. Test model of the inward-flow turbine (1930) developed 500 hp at 25,000 rpm in one stage of expansion. Rotor tip diameter 13.2 inches

RECENT developments in the field of small gas turbines have focused new attention on the radial inward-flow principle of turbine design. Though the interest has been great, the greatest merit of the inward-flow design has been overlooked, according to Rudolph Birmann, consulting engineer for the DeLaval Steam Turbine Co. He points out in a recent ASME paper (No. 53-S-16) that the inward-flow turbine can be designed for specific outputs far exceeding those of the axial-flow wheel. This characteristic he attributes to the ability to handle larger flows and higher enthalpy drops at higher rpm with better efficiency and lower stresses.

In the hydraulic turbine field, the inward-flow (centripetal) turbine — known as the Francis turbine — has been used widely for the past 100 years. No counterpart of the Francis turbine was designed for elastic fluids, however, until studies by DeLaval, begun in 1928, led to the construction of two different experimental units.

Experiments with these units led to the abandonment of the low-specific-speed version, and concentration on the high-specific-speed version (see Fig. 1). Studies and experimentation proved the low-specific-speed type to be inferior to the axial-flow in many cases. The high-specific-speed unit frequently can be used to better advantage than the axial-flow type.

Three limitations are characteristic of the inward-flow turbine, though they are not always considered disadvantages. They are:

1. It usually occupies a greater axial space than an equivalent axial-flow type.
2. The stationary flow passages must be arranged outside the turbine wheel to allow radial inward feed into the wheel.
3. Multistaging is not as simple as it is with the axial-flow type, but it can be done (see Fig. 2). This may limit the design to single stage turbines or to the last stage or stages of multi-stage turbines.

Contrasted to the preceding limitations, the following distinct advantages over the axial-flow turbine are offered by the inward-flow type:

1. It is capable of handling larger flows and/or of operating at higher rpm under conditions of equal stress.
2. It is capable of handling larger stage enthalpy drops efficiently.
3. It gives higher turbine efficiency because the following factors are taken into account:

a. The effect of expansion takes place *against* the centrifugal force.

b. It operates at a higher Reynolds number.

c. It operates at a lower Mach number.

d. Blades can be designed for balanced flow, while all-radial blade sections are maintained.

e. Excellent recovery is possible in a simple diffuser of the kinetic energy leaving the turbine blades.

4. It is simpler and cheaper to manufacture and is more rugged because of the low number of blades and because of their configuration.
5. The blades and hub can be made as a single piece, eliminating the age-old problem of blade fastenings.
6. It has a lower moment of inertia for more rapid acceleration.
7. Blades and hubs can be air-cooled effectively in a simple manner, permitting operation with very high gas temperatures for which the strength of the uncooled metal would be insufficient.

Inward-flow turbines have been operated successfully on engine exhaust gases to drive superchargers and on process waste gases to drive other power equipment. Their application to aircraft and marine propulsion is feasible (see Fig. 2) and in some cases has been accomplished.

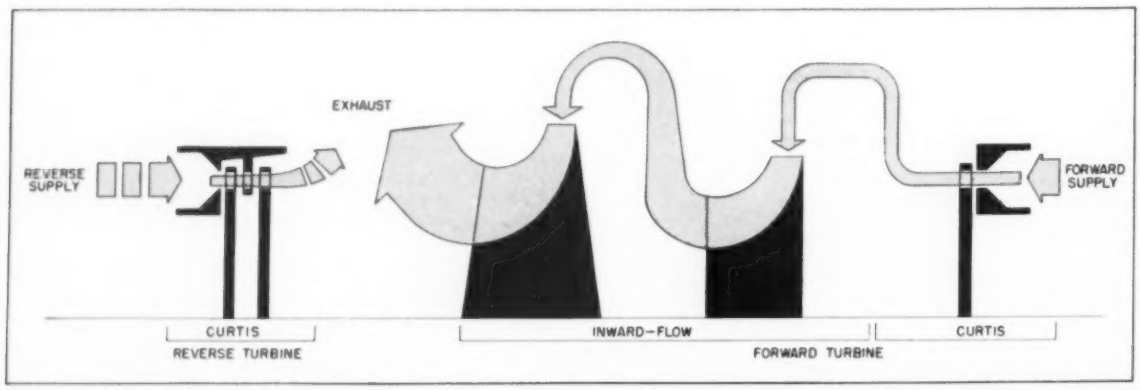
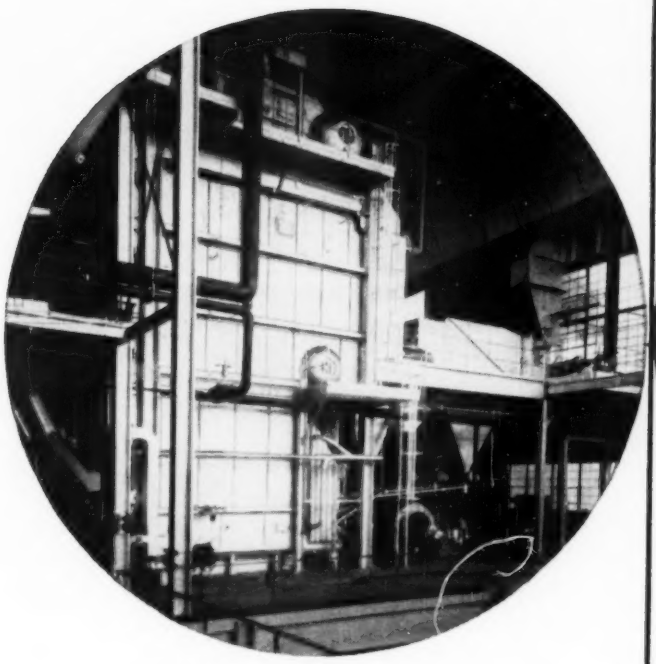


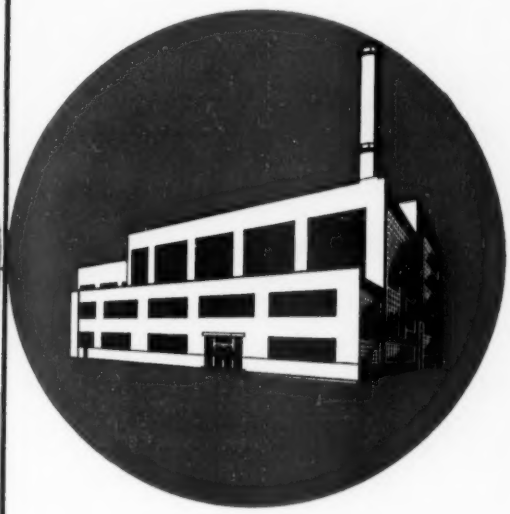
Fig. 2. Flow pattern through one impulse stage and two inward-flow stages (ahead) and two impulse stages (astern) of a sub-chaser low-pressure turbine

City of Manitowoc installs fifth WICKES steam generator

To provide a dependable source of power for the City of Manitowoc, Wisconsin, the Manitowoc Public Utilities Commission has just installed a fifth WICKES Steam Generator capable of producing 175,000 lbs. of steam per hour at 525 psi. Final steam temperature is 750°F. The new WICKES Boiler has 11,600 sq. ft. of heating surface. It is equipped with an economizer and fired by spreader stoker.



R. E. Connard — Chief Engineer and General Manager



WICKES can fill your requirements for all types of multiple drum boilers generating up to 250,000 lbs. steam per hour at pressures up to 1000 psi. adaptable to any standard method of firing — oil, gas, single retort underfeed or spreader stoker. For pressures up to 900 psi. with sustained steam production up to 35,000 lbs. WICKES Type A Boilers can be shop assembled, ready for immediate installation. Write today for descriptive literature or consult your nearest WICKES representative.

wickes

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150

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Cost Comparisons of Small Steam Turbine and Oil Engine Parts

Between 2500 and 10,000 kw, oil and gas engine plants compete with small steam turbine plants. Costs are compared here for a number of these small generating plants

By
HERBERT B. REYNOLDS
Consulting Engineer

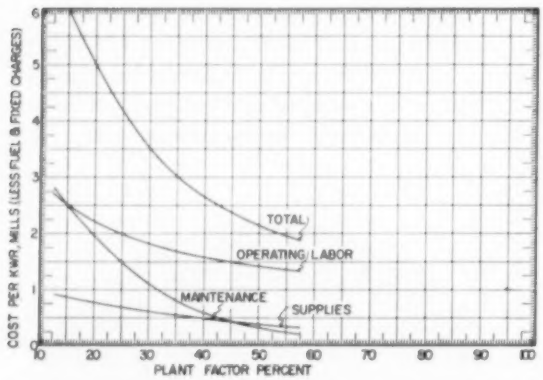


Fig. 1. Oil engine plants—relation between plant factor and cost per kwh, less fuel and fixed charges, for comparison with the curves of Fig. 2

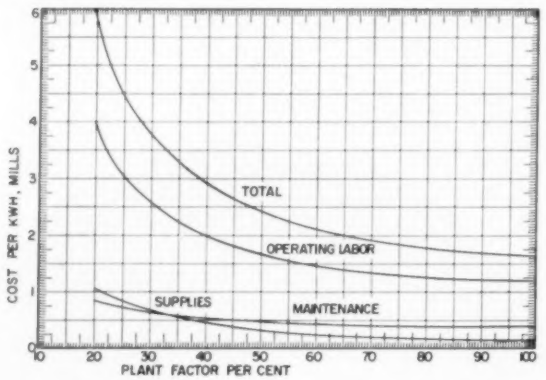


Fig. 2. Small steam turbine plants—relation between plant factor and cost per kwh, less fuel and fuel charges, for comparison with Fig. 1 curves

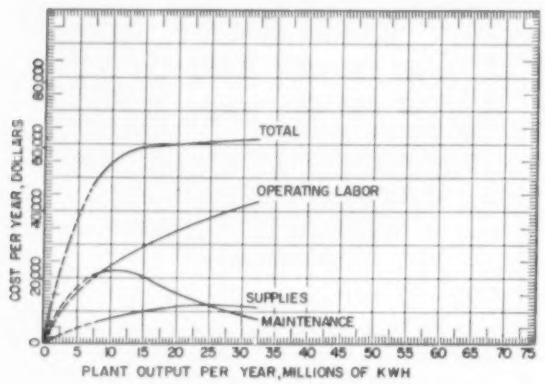


Fig. 3. Oil engine plants—relation between plant output and cost per year in dollars, less fuel and fixed charges; to compare with Fig. 4

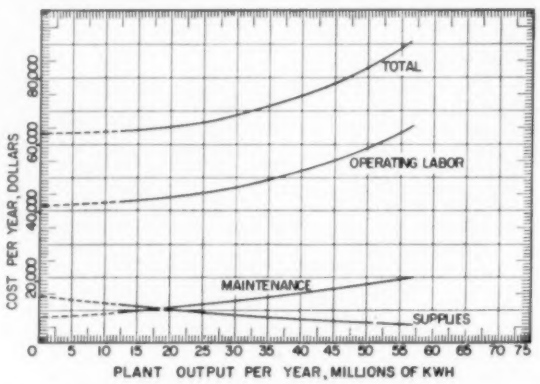


Fig. 4. Small steam turbine plants—relation between plant output and costs, less fuel and fixed charges. Note the differences from Fig. 3

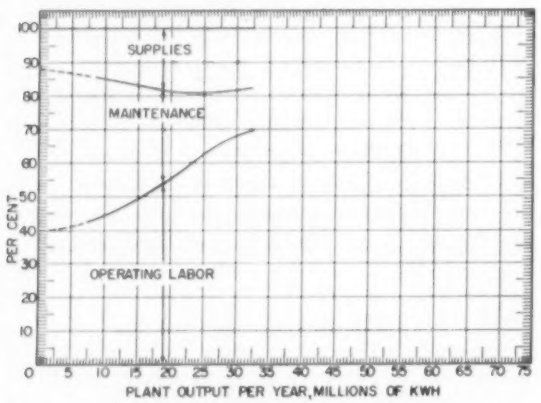


Fig. 5. Oil engine plants—showing relation between plant output and distribution of costs, less fuel and fixed charges; distribution in per cent

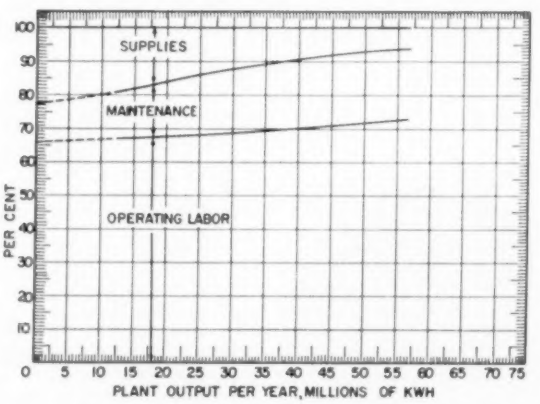
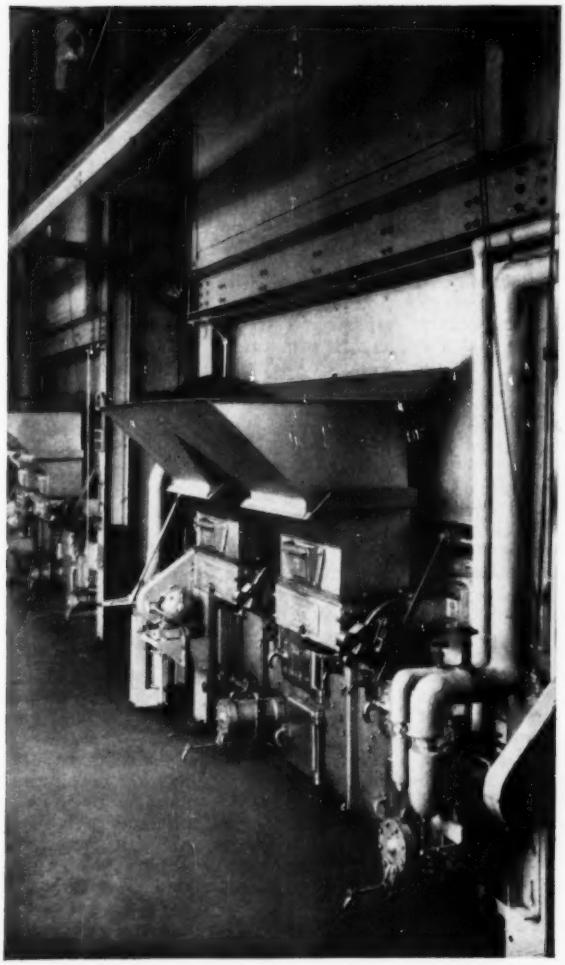


Fig. 6. Small steam turbine plants—relation between plant output and the percentage distribution of costs, less fuel and fixed charges

For text, turn to page 104



old or new...

no boiler is better than its *Tubes*

Starting with this fact, it is reasonable and practical to install the best available boiler tubes—in terms of potential service life—in any boiler. Since all boiler tubes produced by quality mills must and do conform to the same specifications for the same job, the choice of a better boiler tube must go beyond specifications and visible comparisons. Boilers of all types—equipped with B&W boiler tubes—have been meeting utility, industrial, and every other kind of rugged service requirement, large and small, over the years. When better boilers are built, you will find them equipped with B&W Tubes.

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B&W SEAMLESS and WELDED TUBES

THE BABCOCK & WILCOX COMPANY
TUBULAR PRODUCTS DIVISION
Beaver Falls, Pa.—Seamless Tubing; Welded Stainless Steel Tubing
Alliance, Ohio—Welded Carbon Steel Tubing TA-1759 (A)

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Table I. Comparison of operating and maintenance costs for 1951—oil engine and small steam turbine plants, giving maximum, minimum and average data

	Oil Engine Plants	Steam Plants
Number of Plants (except where noted)	18	18
Maximum Capacity of Plants, kw	10,125	10,000
Minimum Capacity of Plants, kw	2,578	2,500
Average Capacity of Plants, kw	6,400	6,550
Maximum Plant Factor, %	57.5	110.0
Minimum Plant Factor, %	12.3	17.1
Average Plant Factor, %	29.9	55.8
Maximum Operating Labor Cost, Mills per kwh	4.11	5.54
Minimum Operating Labor Cost, Mills per kwh	1.08	0.72
Average Operating Labor Cost, Mills per kwh	1.68	1.54
Maximum Maintenance Cost, Mills per kwh	3.19	1.09
Minimum Maintenance Cost, Mills per kwh	0.18	0.13
Average Maintenance Cost, Mills per kwh	1.08	0.52
Maximum Cost of Supplies, Mills per kwh	1.30	1.40
Minimum Cost of Supplies, Mills per kwh	0.19	0.06
Average Cost of Supplies, Mills per kwh	0.55	0.24
Maximum Cost Exclusive of Fuel, Mills per kwh	7.88	7.53
Minimum Cost Exclusive of Fuel, Mills per kwh	1.71	1.04
Average Cost Exclusive of Fuel, Mills per kwh	3.31	2.30
Maximum Cost of Fuel, Mills per kwh	11.10	7.63
Minimum Cost of Fuel, Mills per kwh	1.98	1.07
Average Cost of Fuel, Mills per kwh	6.05	5.05
Maximum Total Cost, Mills per kwh	18.98	11.69
Minimum Total Cost, Mills per kwh	3.69	2.70
Average Total Cost, Mills per kwh	9.36	7.35
Maximum Btu per kwh Net Generation	(1) 13,690	(2) 25,030
Minimum Btu per kwh Net Generation	(1) 10,300	(2) 13,367
Average Btu per kwh Net Generation	(1) 12,170	(2) 17,275
Maximum Cost of Fuel, Cents per Million Btu	(1) 92.8	(2) 40.2
Minimum Cost of Fuel, Cents per Million Btu	(1) 16.0	(2) 5.3
Average Cost of Fuel, Cents per Million Btu	(1) 50.1	(2) 25.0
Maximum Cost of Plants, Dollars per kw	(4) 204	(3) 531
Minimum Cost of Plants, Dollars per kw	(4) 74	(3) 88
Average Cost of Plants, Dollars per kw	(4) 138	(3) 222

Table II. Operating and maintenance costs for 1951—oil engine and small steam turbine plants and including a natural gas turbine plant of same size

	Oil Engine Plants	Steam Plants	Gas Turbine Plants
Number of Plants (except where noted)	18	18	1
Average Capacity of Plants, kw	6,400	6,550	6,000
Plant Factor, %	20.6	20.6	20.6
Operating Labor Cost Mills per kwh	2.20	3.78	2.25
Maintenance Cost Mills per kwh	1.90	0.81	2.04
Cost of Supplies Mills per kwh	0.77	1.03	1.17
Cost, Exclusive of Fuel Mills per kwh	4.87	5.62	5.46
Maximum BTU per kwh net Generation	(1) 13,690	(2) 25,030	15,048
Minimum BTU per kwh net Generation	(1) 10,300	(2) 13,367	15,048
Average BTU per kwh net Generation	(1) 12,170	(2) 17,275	15,048
Maximum Cost of Plant Dollars per kw	(4) 204	(3) 531	155
Minimum Cost of Plant Dollars per kw	(4) 74	(3) 88	155
Average Cost of Plant Dollars per kw	(4) 138	(3) 222	155

Notes: These apply to both Tables I and II.

Data for oil engine plants taken from ASME Report on Oil and Gas Engine Power Costs for 1951, except where noted.

Data for steam plants and gas turbine plant taken from Federal Power Commission publication Steam-Electric Plant Construction Cost and Annual Production Expenses for 1951.

All averages are weighed.

(1) Data for only 17 plants available.
(2) Data for only 13 plants available.
(3) Data for only 14 plants available.
(4) Data taken from Federal Power Commission report on Internal-Combustion Engine Electric Generating Stations, 1948.

ALTHOUGH most of the power produced in the United States is generated by large steam turbine and hydro plants, a considerable portion is furnished by oil and gas engine plants. For central stations of capacities less than about 2500 kw, oil and gas engines are used almost exclusively, but for capacities between 2500 kw and 10,000 kw, the field is shared by the oil and gas engine and small steam turbine installations. For capacities greater than about 10,000 kw, the steam turbine and hydro plants have the field almost exclusively. One possible exception to this, although it is an industrial plant and not a central station, is the radial gas engine plant at Port Lavaca, Tex., owned by The Aluminum Company of America, having a capacity of 220,000 kw in the form of 194 radial gas engine-generator units. (For costs of these, see POWER ENGINEERING, April, 1953; also see July issue page 58.)

Existence of a number of both oil engine and steam turbine plants within the range of 2500 kw to 10,000 kw provides an opportunity for comparing operating costs of these two types of power sources. Use has been made of the data covering 18 oil engine, or predominantly oil engine installations as published in the ASME Report on Oil and Gas Engine Power Costs for 1951 and 18 steam turbine plants of approximately the same capacities as published in the Federal Power Commission report on Steam-Electric Plant Construction Cost and Annual Production Expenses also for the year 1951.

Relation to Plant Factor

Table I summarizes data for the 36 plants under study. When comparing the data in this table it should be kept in mind that the average plant factor for the oil engine plants is considerably lower than that for the steam turbine plants. This is probably because many of the oil engine stations are stand-by plants or are used only for peak loads, for which they are particularly well suited.

Various factors of the plants under consideration were studied such as size, heat rate and so on, in an attempt to determine the effect of these factors upon cost of operation and maintenance. The only factor that was found to have a consistent relation with the cost of operation was the plant factor which is defined by the AIEE as: The ratio of the average load on the plant, for the time considered, to the aggregate rating of all the generating equipment installed in the plant. Cost of fuel has been omitted from this comparison because fuel prices are influenced so largely by plant locations.

Figure 1 shows the relation between the plant factor and the various elements making up the operating cost exclusive of fuel and fixed charges in oil engine plants, while Fig. 2 gives the same relation for small steam turbine plants. Although the points for each plant were scattered, points on these charts were obtained by averaging groups of points. These average points fell on or extremely close to the curves as shown.

Each of the curves giving the component parts of the cost were drawn first on separate sheets and then transferred to Figs. 1 and 2. Very slight adjustment of these curves was necessary to make the sum of the ordinates of the individual curves agree with the ordinates of the curves giving total costs. This close agreement would indicate that the data are consistent and that the resultant curves show the relations fairly accurately.

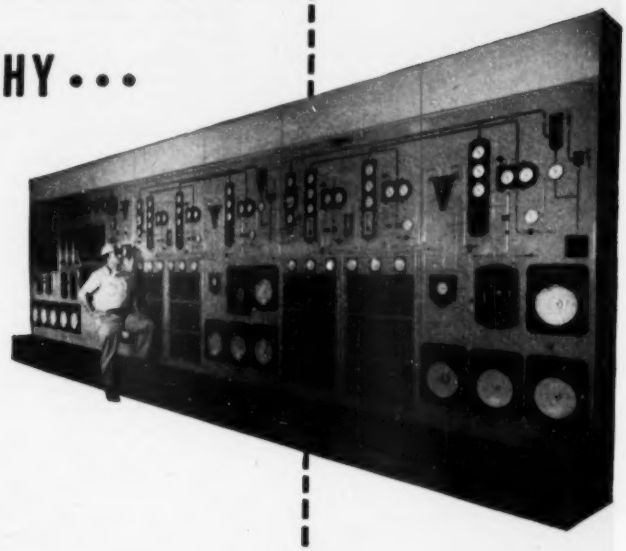
Output and Cost

Comparison of the curves in Figs. 1 and 2 disclose some interesting differences in their characteristics. Cost of supplies declines at a faster rate with an increase in plant factor for the steam plants than it does in the oil engine plants. Greatest difference is observed in the shape of the curves giving maintenance and operating labor costs. Maintenance cost of the oil engine plants declines very rapidly with an increase in plant factor compared with the maintenance cost of the steam plants, while the curve giving labor cost for the steam plants declines at a faster rate. This difference led to the plotting of Figs. 3 and 4.

(*Continued on page 113*)

6 REASONS WHY...

PANELLIT is the largest builder of process control panels



1 **SPECIALIZED ENGINEERING** . . combining instrumentation and process experience, PANELLIT provides sound and economical engineering as a part of their service.

2 **ADVANCED STANDARDS OF CONSTRUCTION** . . . have distinguished PANELLIT in every detail of structure, finish, piping, terminal arrangements and serviceable behind-the-panel layouts.

3 **PIONEERING CONCEPTS OF INSTRUMENTATION** . . . the graphic control panel, miniature instrumentation, unitized annunciator systems, scanning and monitoring devices . . . all have been closely associated with PANELLIT.

4 **ORGANIZATIONAL FLEXIBILITY** . . . Few process control panels are ever shipped without changes. When "change orders" are received, PANELLIT moves quickly to carry them out . . . without confusion . . . without delay. Where others take weeks, PANELLIT takes hours.

5 **THE ONE MAN PLAN** . . . makes PANELLIT easy to work with. One project engineer stays with your job. There are no "pass along instructions" or "round about authority".

6 **INFORMATION SYSTEMS** . . . an advanced PANELLIT concept of the control panel has resulted in better process control. An *information system* filters information for the operator to know . . . and presents it in a manner that he may act quickly and instinctively. *Write for complete information.*

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INFORMATION SYSTEMS

PANELLIT, INC., 6312 N. BROADWAY

CHICAGO 40, ILLINOIS

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Whiting Plant

(Continued from page 66)

14,400 v to 140 kv. All synchronizing and switching under load is done on the high-tension side of the transformer.

Auxiliary power for starting is obtained from a 2400-v transfer bus energized from a 3-winding station power transformer (shown as bank No. 7) which can receive energy from the 140-kv bus system or from either of two 44-kv lines connected to transmission substations in this area. As soon as the unit is synchronized to the line, the station power is transferred to station power bank for that unit, which receives its energy direct from the generator terminals. Relays are provided so that, in case of trouble with the unit station power transformer, station power for those auxiliaries automatically will transfer back to the transfer bus.

As mentioned before, station power switches are located in the 22-ft space between turbine and boiler rooms. This central location keeps the power cables as short as possible. In line with this, the unit station power transformers are located on the roof directly above this part of the building, only a few feet above the turbine room roof. This not only shortens the power leads but also conserves space in the substation and shortens the expensive main generator cables. All motors of 100 hp or more operate at 2400 v, and smaller motors at 480 v.

Why No Freight Elevator?

A 2500-lb capacity, 6-ft by 5 ft-9 in. cab, 300-ft-per-min, completely-automatic, combination freight and passenger elevator is provided centrally near the office end of the plant, and a 1200-lb capacity 4 ft-2 in. by 3 ft-10 in. cab, 250-ft-per-min passenger elevator is located centrally beyond the second boiler. Both elevators go from basement to fan floor with landings at all floor or platform levels. The relatively high speed is provided as an aid to operation, but the larger elevator has sufficient capacity to handle all normal maintenance materials.

No regular freight elevator is provided, for experience has shown that very seldom is it necessary to handle equipment over 2500 lbs. To provide for such emergencies if they occur, a heavy trolley beam is located below the boiler room roof trusses. At a point under this beam is located an open hatchway all the way from fan floor to basement. At floor levels where desirable, this hatchway is covered by removable grating. A 10-ton electric trolley hoist is mounted on this trolley beam, which makes it possible to handle any necessary equipment, too heavy for the elevator, to any floor level.

An extension of this trolley beam is carried through suitable doors in the boiler room wall, and parallel to the wall, over the station power transformers, thus making it readily possible to remove or replace these transformers should occasion require.

Fire Protection

Fire protection and plant house service water are supplied by the house service pumps mentioned before. At the start of construction, a 100,000-gal elevated tank 200 ft high, Fig. 1, was erected with temporary pumps to provide fire protection during construction. With the completion of the screen house, this tank and the house service pumps were connected to an underground water main, which completely encircles the plant. Fire hydrants connected to this main supply protection

(Continued on page 108)

Principal Equipment, Justin R. Whiting Plant, Consumers Power Co., Erie, Michigan

STEAM GENERATING EQUIPMENT

Steam Generators, 2—Radiant, reheat type; each 690,000 lb per hr maximum, 1650 psi design pressure, 1480 psi working pressure, final steam temperature 1000 F; steam reheat to 1000 F; 14,753 sq ft heating surface; furnace volume 52,300 cu ft. Superheaters, primary and secondary, separated by B&W attemperators. Reheater, 13,000 sq ft, with attemperator. Economizer, 14,300 sq ft. Air heater, single pass, tubular, 2 parallel sections, heating surface 227,000 sq ft. All by The Babcock & Wilcox Co.

Fuel Equipment—Burners, 12 per boiler (3 per mill) circular, turbulent, in burner windbox; each with mechanical atomizing oil burner for lighting off; each horizontal row fired from 1 pulverizer. Pulverizers: 4 per boiler, capacity each 26,000 lb per hr of coal at 12 per cent moisture, grindability 55; 75 per cent through 200 mesh; driven by GE 125-hp motor. All by The Babcock & Wilcox Co.

Automatic Steam Temperature Control—For superheater and reheater attemperators, Copes-Vulcan Div. Continental Foundry & Mach. Co.

Forced-Draft Fans, 1 per boiler—Each No. 736 Series 86, double-inlet, double-width, capacity 230,000 cfm at 100 F, 12 in. H_2O, 855 rpm, driven through Thomas flexible coupling and type PE hydraulic coupling by GE 565-hp motor. American Blower Corp.

Induced-Draft Fans; 1 per boiler—Each No. 790 Sirocco, Series 90, double-inlet, special ⅔ double-width, capacity 350,000 cfm at 275 F, 15 in. H_2O, 560 rpm. Driven through Thomas flexible coupling and PE hydraulic coupling by GE 1250-hp motor. American Blower Corp.

Tempering Air Fans; 2 per boiler—Each 30,000 cfm at 100 F, 3.5 in. H_2O, 865 rpm. Driven through Thomas flexible coupling by GE 25-hp motor. American Blower Corp.

Dust Collectors—1 Primary, 2 secondary per boiler, mechanical type ST. Efficiency 85% at 315,000 cfm at 275 F, 2.2 in H_2O; 2 Type E secondary fans, each 11,200 cfm at 275 F, 7.6 in. H_2O, driven at 1170 rpm by GE 30-hp motor. American Blower Corp.

Oil Burning Equipment—The Babcock & Wilcox Co.

Water Level Indicators and Recorders—Hagan Corp.

Gage Glasses.....Diamond Power Specialty Corp.

Boiler Safety Valves.....Foster Engineering Co.

Soot Blowers—Air-operated, automatic. Diamond Power Specialty Corp.

Blow-off Valves—(Hancock) Manning, Maxwell & Moore, Inc.

Automatic Combustion Control—The Leeds & Northrup Co.

Boiler Ductwork.....Litell Iron Works

Stacks, 1 per boiler—Steel, 11 ft diameter, 300 ft. high. Bigg Boiler Works.

COAL AND ASH HANDLING

Car shakeout.....Robins Conveying Belt Co.

Belt Conveyors.....Link Belt Co.

Crusher—450 ton per hr, (Pennsylvania ring crusher). Link Belt Co.

Coal Scales.....Merrick Scale Mfg. Co.

Coal Meters.....Bailey Meter Co.

Bulldozers.....International Harvester Co.

Ash Handling Equipment—Ash hoppers, sluice, piping, etc. Allen—Sherman—Hoff Co.

Ash Sluice Pumps.....Morris Machine Co.

Oil-fired car thawing pits—Groak Engineering Corp.

Diesel-Electric Locomotive.....General Electric Co.

Coal Bunkers.....Whitehead & Kales Co.

Conveyor & Bunker Exhaust System Pangborn Co.

FEEDWATER EQUIPMENT

Make-up Water Treatment System—Hot process lime and soda ash system. Graver Water Conditioning Co.

Evaporators, 2—Horizontal, single effect; Capacity each 10,000 lb per hr vapor at 61 psia, 294 F, 29 per cent sq ft heating surface. The Griscom Russell Co.

Chemical Proportioning Pumps—Milton-Roy Pump Co.

Feedwater Heaters—High-Pressure heaters; 2 per unit. Style LSU, horizontal, 2-pass. 3580 sq ft each, capacity 690,000 lb per hr of water, maximum 470 F. Tubes designed for 2250 psi, shells 450 and 250 psi. Low-pressure heaters, 3 per unit; Type SSU horizontal, 2 pass, 3960 sq ft each, capacity 690,000 lb per hr of water heated in 3 heaters from 80 to 388 F. Tubes and shells designed for 200 psi. Heater drain cooler, 3110 sq ft, tubes and shell, for 200 psi, capacity 227,000 lb per hr of heater drains. All by The Griscom Russell Co.

Boiler Feed Pumps—2 per boiler, Type HDB, horizontal, 9-stage, each 1900 gpm at 1775 psi. Driven through American Blower Corp. Gyrol fluid driven and Fast's couplings by GE 2000-hp motor. Byron Jackson Co.

Clear Well Storage Tanks—Sharpsville Steel Fabricators

TURBINE GENERATOR EQUIPMENT

Turbine Generators, 2—Tandem-compound, single-shaft, double-flow reheat turbines, 5 extraction points for regenerative feedwater heating. Throttle steam 1450 psi, 1000 F; reheat to 1000 F, exhaust at 1 in. Hg back pressure; speed 3600 rmp. Rated capacity each 85,000 kw. Generator, synchronous, hydrogen-cooled 0.85 pf, 60 cycle, 3 phase, 14,440 v, 4005 amp, wye-connected. Exciter, 270 kw, with 4 kw pilot exciter. Maximum capability 104,800 kw at 0.85 pf, and 1 in. Hg. General Electric Co.

Condensers, 2 (1 per turbine)—Double flow deaerating, capacity each 450,000 lb steam per hr, 60,000 gpm circulating water at 75 F. Surface 47,500 sq ft; 2-pass vertically-divided surface condenser. Air-ejectors, 2-stage twin-element, inter and after condenser. Ingersoll-Rand Co.

Condenser Circulating Water Pumps, 2 per unit—Vertical, single-stage turbine type; size 26 APM; each 30,000 gpm 580 rpm, total head 30 ft, driven by 300-hp vertical hollow-shaft motor. Ingersoll-Rand Co.

Condensate Pumps, 2 per unit—Vertical 4 stage, size 20-APKC; 1600 gpm, 380 ft TDH, driven by vertical 200-hp, 1150 rpm vertical solid shaft motor. Ingersoll-Rand Co.

Traveling Screens.....Chain Belt Co.

Intake Racks.....R. C. Mahone Co.

Intake Rack Power Rakes.....Link Belt Co.

Chlorination Equipment for Condenser Circulating Water—Dry gas Feed, Consumers Power Co. design.

OTHER MECHANICAL EQUIPMENT

Soot-blower Air Compressors, 2—Vertical angle, 3 cylinder, 3 stage driven by 300-hp 435 rpm, drip-proof squirrel cage motor. Worthington Corp.

Crane, 1—Turbine room, main hoist 175 tons, auxiliary hook 25 ton, span 114 ft. Shaw Box Crane & Hoist Div., Manning, Maxwell & Moore, Inc.

Water Tank, 1—For house service and fire protection; 100,000-gal. Chicago Bridge & Iron Co.

House Service Pumps.....Ingersoll-Rand Co.

Bearing Cooling Water....Taken from house service.

Miscellaneous Pumps.....Union Steam Pump Co.

Structural and Boiler Steelwork—Whitehead & Kales Co.

Passenger Elevators.....Otis Elevator Co.

Foundation Work.....Raymond Concrete Pile Co.

Building Brickwork.....Herlihy Mid-Continent Co.

Power Plant Piping System—Babcock & Wilcox. Dravo Co. and Shaw-Kendall Co.
High pressure valves.....Powell and Hancock
Lower-pressure valves, check valves, motor-operated valves.....Wm. Powell Co.
Power-operated relief valves—(Consolidated). Manning, Maxwell & Moore, Inc.

Instrumentation
Temperature Recorders....The Leeds & Northrup Co.
Turbine instruments.....General Electric Co.

ELECTRICAL EQUIPMENT

Main Power Transformers, 2—Three-phase, 14 kv/140 kv. Westinghouse Electric Corp.

Station Power Transformers, 2—Three-phase, 15 kv/2400 v

Main Switchgear—138 kv;..... General Electric Co.

Station Power Switchgear—Metal-clad air breakers, 4160 v. General Electric Co.

Auxiliary Motors.....General Electric Co.

★ ★ ★

General Contractor.....Herlihy Mid-Continent Co.

Designing Engineers.....Commonwealth Associates

COAL MOVES RAPIDLY FROM FACE TO TIPPLE
IN BEACON'S MODERN MECHANIZED MINES

BEACON COAL

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Carolina Power & Light

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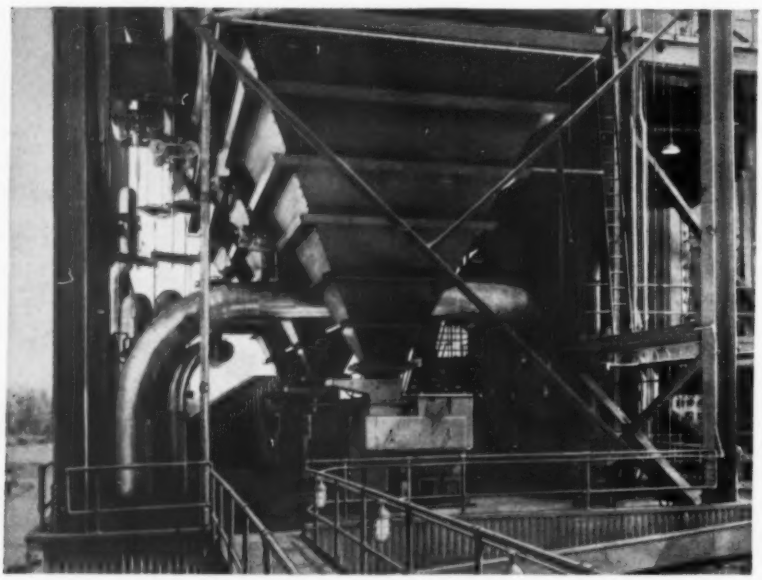
Richardson

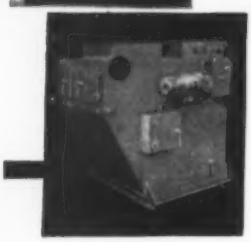
Richardson Automatic Coal Scales are playing a vital part in helping supply power for the new Industrial South. Here are Richardson Model 39's in an outdoor installation at the new generating station of Carolina Power and Light.



To both industrial and utility power generating stations, specifying Richardson means—

1. A 24" x 24" inlet opening and 26" wide belt for maximum coal flowability.
2. All wiring and controls outside coal chamber.
3. Access doors which will not spill dust on floor when opened.
4. Beam ratio test facilities outside coal chamber.
5. Gravity operated by-pass, with no restriction of coal flow to downspout.
6. No drag links or wires attached to weigh hopper.
7. Nationwide after-delivery service.

Latest development in the 39 Series of Richardson Automatic Coal Scales is the Model H-39 shown below. May we send you our new 16-page engineering data book on the H-39 Coal Scale (Bulletin 0352), without cost or obligation?



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Richardson

MATERIALS HANDLING BY WEIGHT SINCE 1902

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(Continued from page 106)

service outside the plant and in the substation. Connections from this main are brought into the plant to supply bearing cooling water, fire cabinets, and other house service needs, with a valve arrangement such that any part of the system can be isolated for repairs without interfering with the supply to the rest of the system.

Keeping Bleed Lines Short

Location of the station power switch rooms in the space between the turbine room and boiler room allows space below the operating floor level for the boiler feed heaters and the evaporators, at mezzanine floor level. Heaters and evaporators are horizontal and all heaters are designed with subcoolers for condensate. This location of the heaters keeps the bleed steam lines short and allows ample space for operation and maintenance.

A hot process lime and soda ash softener supplies deaerated softened water for the feed to the make-up evaporators. This softener is located in a separate room above the coal bunkers, which elevation provides sufficient head to feed the evaporators without the use of an evaporator feed pump.

The design provides no central control room, as studies show that with this design there would be no saving in man power required, and it is felt that there is an advantage in having the man responsible for the operation where he can see and hear the equipment for which he is responsible.

First unit was put in operation in July, 1952 and the second unit during last November. While construction work is not quite complete and plant operation is not quite normal, the results thus far fully meet the design expectation, and starting troubles have been surprisingly few.

As this is written, the project is still under construction. Plans are well under way for inexpensive but suitable landscaping with lawn, trees, and shrubbery, and the necessary parking areas for both employees and visitors.

Clean Condensers

(Continued from page 78)

comparison with a clean tube corrected value of 591 Btu. After the condenser was cleaned with wire brushes, the cleanliness factor increased from 55.8 to 62 per cent. It was decided that a more effective tool was needed and a pneumatically driven descaling tool was tried. Cleaning half of the condenser only increased the cleanliness factor to 63.5 per cent. All the scale could not be removed without damaging the tube. The expense and time involved did not justify mechanically cleaning the other half of the condenser.

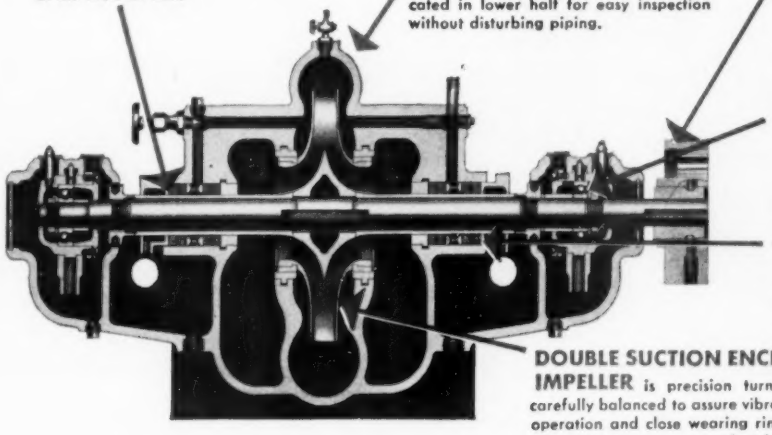
(Continued on page 111)

Look for These 7 Signs of GOOD PUMP DESIGN

CAST SHAFT SLEEVES, not commercial tubing, save the shaft from wear. Sleeves extend through the stuffing box and seal at the impeller hub.

HEAVY HORIZONTAL SPLIT CAST-IRON CASING construction with suction and discharge nozzles located in lower half for easy inspection without disturbing piping.

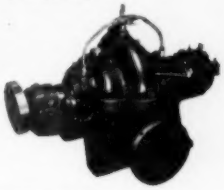
COUPLINGS have *Magic-Grip* quick change bushings for pump and drive shaft. Pin and rubber bushing type usually used. Removal for maintenance is easy.



BALL BEARINGS may be furnished for either oil or grease lubrication. Sleeve bearings also available in larger sizes.

GENEROUS STUFFING BOX LENGTH contains sufficient packing to keep stuffing box maintenance low. Provision is made for sealing water connections or for grease seal if these are required.

DOUBLE SUCTION ENCLOSED IMPELLER is precision turned and carefully balanced to assure vibrationless operation and close wearing ring clearance. Water passages are hand finished to a smooth surface.



STANDARD AND SPECIAL MATERIALS are available for many types of service where government regulations permit. Iron, bronze, stainless steel and combinations of these materials handle both alkaline and acid solutions. Standard sizes carried in stock range from 10 to 7000 gpm with heads as high as 475 feet.

ALLIS-CHALMERS Double Suction PUMPS

THESE DESIGN AND CONSTRUCTION features of Allis-Chalmers double suction pumps assure long pump life and low maintenance costs. Every A-C double suction pump is carefully tested on the most modern pump testing equipment in the industry.

Complete Pumping Unit

Allis-Chalmers can furnish the complete pumping unit — pump, motor, control and drive — all of coordinated design and manufacture.

Whatever your pumping problem, call your nearby Allis-Chalmers Authorized Distributor or District Office. Or write for Bulletin 08B6146. Allis-Chalmers, Milwaukee 1, Wisconsin.

A-3952

Texrope, Magic-Grip, and Vari-Pitch are Allis-Chalmers trademarks.

Sold . . .
Applied . . .
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by Allis-Chalmers Authorized Distributors, Certified Service Shops and Sales Offices throughout the country.

MOTORS — ½ to 25,000 hp and up. All types.

CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

TEXROPE V-belts in all sizes and sections, standard and *Vari-Pitch* sheaves, speed changers.

ALLIS-CHALMERS

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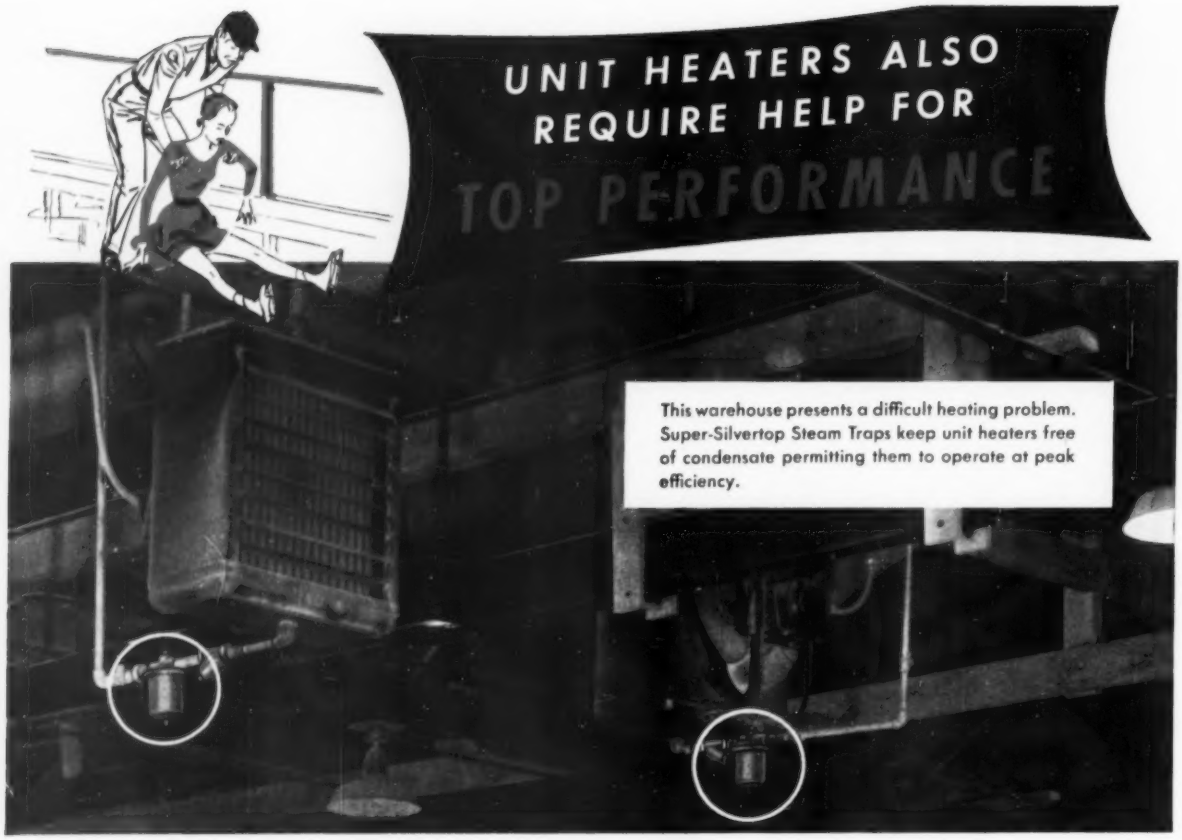
UNIT HEATERS ALSO
REQUIRE HELP FOR
TOP PERFORMANCE
This warehouse presents a difficult heating problem. Super-Silvertop Steam Traps keep unit heaters free of condensate permitting them to operate at peak efficiency.

INSTALL SUPER-SILVERTOP STEAM TRAPS NOW!

Unit heater inefficiencies can't always be blamed on the heater itself. Heaters need help in order to operate at top performance. The faster the heater is freed of air, when turned on, the quicker it is brought to maximum temperature. And by draining condensate out of the core of the steam compartment at all times, the heater continues to operate at peak efficiency delivering heat at its maximum output. Super-Silvertops succeed where other traps fail because they are activated by water only, regardless of temperature.

Presence of water causes the trap to discharge immediately, preventing corrosion by removing gases and condensate. Help your unit heaters to operate effectively. Install Super-Silvertops now.

To select the proper size trap for unit heaters of various capacities, send for a free copy of "Solving Steam Trap Problems" today. Write

THE V. D. ANDERSON COMPANY
1977 West 96th Street • Cleveland 2, Ohio

FREE STEAM TRAP DATA BOOK

This 36 page book contains complete data on the selection of proper size traps for unit heaters.

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Gentlemen: Please send without obligation a copy of "Solving Steam Trap Problems".

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SUPER-SILVERTOPS SAVE MONEY

For more data circle 547 on Post Card

(Continued from page 108)

Heavy load demands did not allow the condenser to be brought down until 27,500 hours had been completed. Provisions then were made to chemically clean the condenser. The performance test following the cleaning showed a cleanliness factor of 78.5 per cent. Cost of the treatment was paid for in 502 hours of operation.

The Dow Chemical Co. at Freeport, Tex., has periodically cleaned this and their other condensers over a period of the last eight years. Many public utilities and other industrial organizations can offer even more impressive results of regular safe and effective cleaning. A typical example of improved performance experienced following chemical cleaning may be seen in Table II. Last year 110 turbine surface condensers were cleaned by our company. Of this group, 39 were cleaned for public utilities.

For those interested in going into every detail of chemical cleaning in all types of condensers and heat exchangers, the paper includes a list of book and magazine reference, which will be sent on request.

Wind Power

(Continued from page 91)

section which is attached to, and rotates with, the hub.

The propeller consists of two blades of aluminum alloy, hinged for coning and maintained by torsion bar springs at a mean coning angle of 5 deg. A constant rotational speed is maintained between wind-speeds 30 mph and 65 mph by an automatically adjusted pitch. The propeller operates at 95 rpm downwind of the tower and orientation is power assisted and controlled.

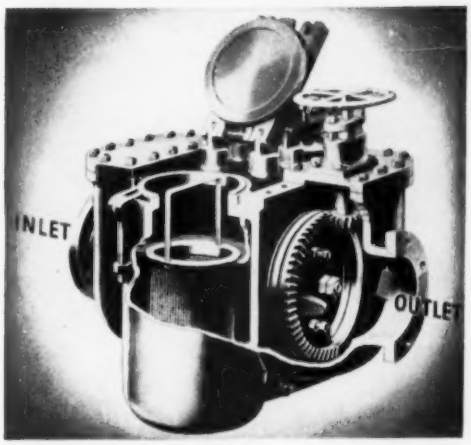
By extracting air from the system by centrifugal force the propeller sets up a pressure difference across the turbine sufficient to cause rotation. The generator is directly coupled to the air-turbine, both being at or near ground level and neither is connected mechanically to the propeller.

With a capacity for handling 50,000 cu ft or about 1.75 tons of air per minute, the single stage, vertical axis, axial flow turbine has a 48-in.-diameter wheel.

The electrical equipment consists of one 100-kw, 415-volt, 3-phase synchronous induction generator with exciter, which is started from rest as an induction motor. When the synchronous speed is approached, direct current is fed into the field thus causing the generator to operate as a synchronous motor running under "no load" conditions. Air is then admitted to the turbine which in turn drives the "motor" in synchronism with the connected system. Fully automatic control gear is connected to the generator by flexible armoured cables. The speed of rotation of both generator and turbine is 1000 rpm.

All electric cables are paper, cambric and rubber insulated while the

R-S Duplex Strainer



- **SINGLE HANDWHEEL CONTROL!**
  Geared turning plate is in constant contact with the seat, cannot become loose or fouled and is fully controlled by 2½ turns of the single handwheel.
- **CLEANED UNDER FULL FLOW!**
  Either of two large interchangeable basket strainers can be removed for cleaning without flow shut-off.
- **ONLY ONE STUFFING BOX!**
  Designed for minimum pressure drop and low maintenance, the R-S Duplex Strainer is available for nearly all liquids in 4-inch to 24-inch pipe sizes. Has no equal for efficient heavy industrial service.

Call your local R-S Engineer or write direct

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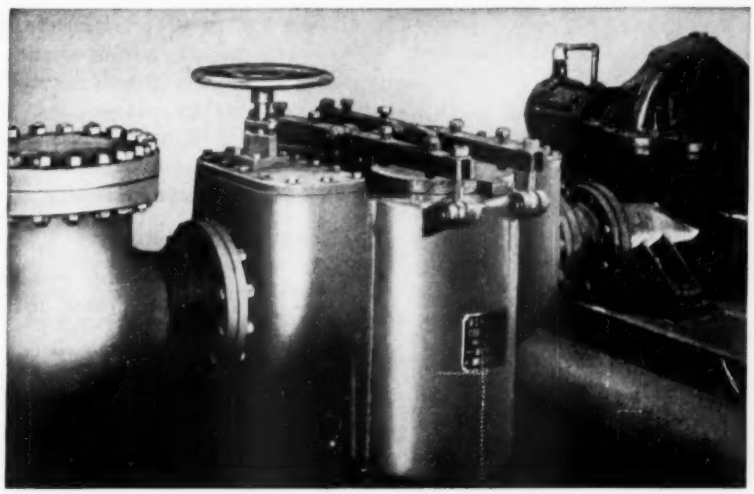

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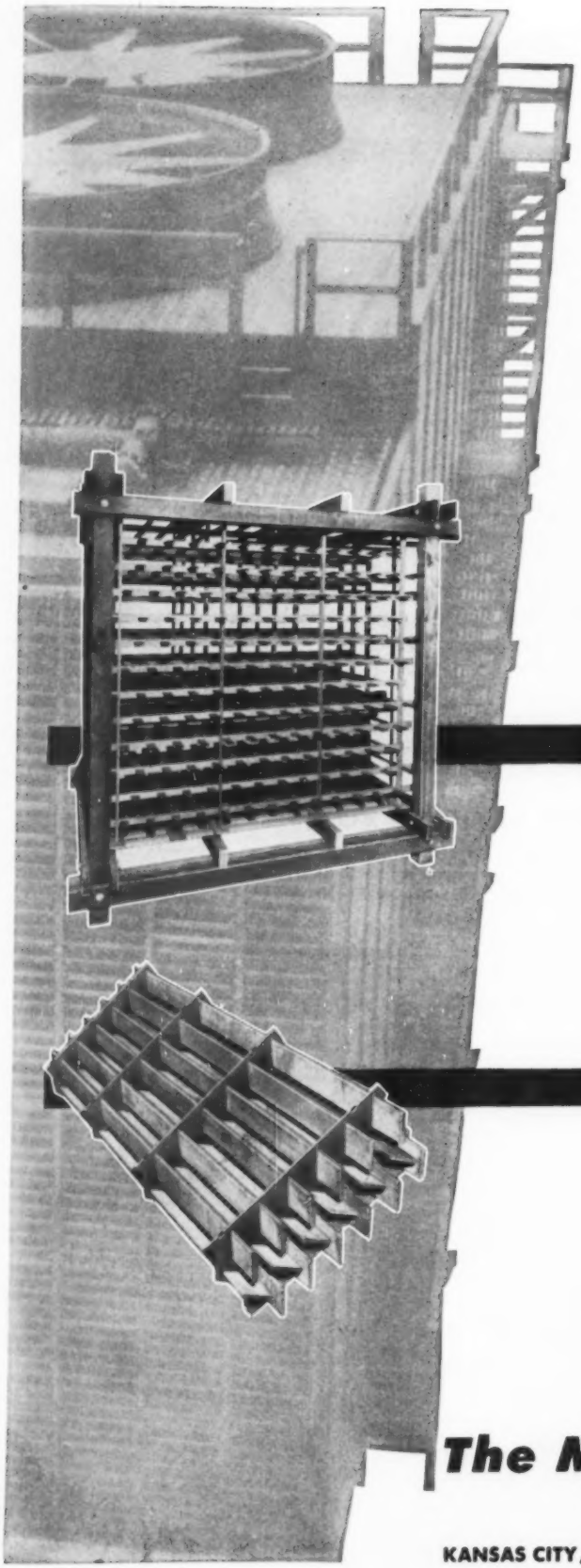


MARLEY design features that mean GUARANTEED PERFORMANCE

What cooling tower purchasers actually buy is ability to meet specific operating conditions. Sturdiness of structure and mechanical excellence dictate the life of the tower, but design alone affords the inherent ability to provide the necessary heat dissipation each process requires. That's why every Marley cross-flow tower is guaranteed to deliver design performance at all times, for only Marley cooling tower design incorporates such advanced features as:

MORTISLOCKED FILLING

This patented Marley filling breaks up the water at every six inches of fall and affords surface retention for longest air-water contact far greater than any other type filling. It achieves this top efficiency while offering absolute minimum obstruction to air flow. Add it up: most frequent water break-up *plus* greatest surface air-water contact *plus* lowest static pressure . . . and you have *peak performance.* MortisLocked filling has no corrosive fasteners to rust or corrode. It can expand and contract freely without warping or sagging.

TRIPLE-EFFECT DRIFT ELIMINATORS

Originally designed by Marley, triple-effect drift eliminators can be used with true efficiency only in Marley cross-flow towers. Position in the tower is of utmost importance for this type eliminator. As an integral part of Marley design, it is placed to best advantage to eliminate the largest quantity of moisture from entrained air without creating undue pressure drop. Marley cross-flow design utilizes 20 per cent greater eliminator area with resultant economy in draft loss and minimized drift.

The Marley Company

KANSAS CITY, MISSOURI

MARLEY

For more data circle 549 on Post Card

12 cables supporting the structure are of galvanized steel, equally spaced, inclined 50 deg and pre-loaded to six tons to reduce fatigue. The total weight of the whole installation is 36.25 tons.

It is possible that the site of this first wind-driven generating station to be connected to the B.E.A. system will be Mynydd Anelog (628 ft) on the Caernarvonshire coast, though this has not yet been definitely agreed.

Paint Identifies Materials

(*Continued from page 93*)

guidance in maintenance work throughout the plant.

Color Aids Maintenance

Standardization of colors can be used to advantage by maintenance supervisors in industrial plants in assuring good paint coverage each repaint period. One utility paints its steel towers and similar equipment a different color each time these structures are painted, say every 5 years. First time, the color universally used was aluminum. Next painting of these same items was green in color. This would be followed by yellow, and so on.

In this way, an automatic record is maintained of the year of the last painting of that particular piece of equipment. Observers can detect any towers or equipment that may have been missed. Inspection of the work of the painters is simplified by the ability to discover unpainted areas quickly. It helps the painters in giving good coverage. Painting aluminum over aluminum makes close inspection difficult. When green is painted over aluminum, towers can be inspected with field glasses or even without them. Work of various contractors can be evaluated more readily by varying the colors as a standard practice.

Undoubtedly many other uses can be made by maintenance departments in wide utilization of paint color to save labor and materials and do a better job.

Cost Comparison

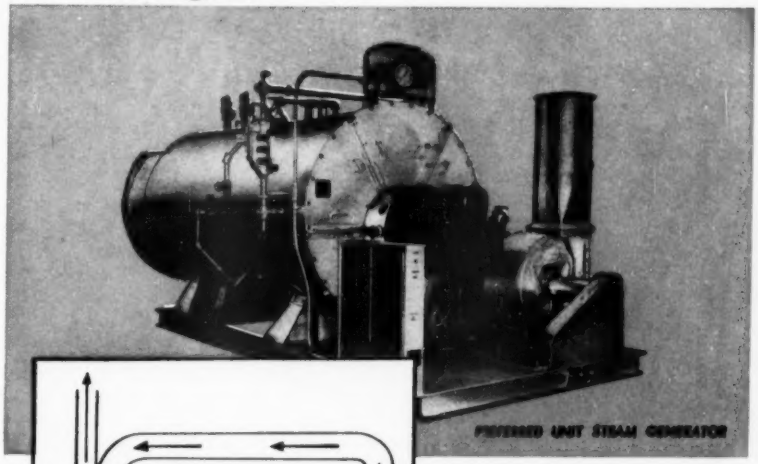
(*Continued from page 104*)

These show the relation between net plant output per year and the cost per year for the various components. These curves were based on Figs. 1 and 2 and on assumed plants having capacities of 6470 kw each, which is the weighed average capacity of the 36 plants used as a basis for this study.

Shape of the curve giving maintenance costs for the oil engine plants is very unusual in that, after reaching a maximum cost of $22,000 per year at an annual output of 11,000,000 kwh it declines rapidly with an increase in output until, at an annual

(*Continued on page 114*)

there *IS* a difference*



*Four Pass Gas Travel — another 25-year built-in Preferred "Quality Feature" that means definite efficiencies and lowered costs.

in gas travel design that means MORE EFFICIENCY and CAPACITY with LESS MAINTENANCE!

Preferred's Unit Steam Generator, with FOUR-PASS GAS TRAVEL, insures a minimum of 80% efficiency and rated capacities that actually means — *MORE STEAM AT LESS COST.*

Everyone knows **heat absorption per square foot of heating surface increases as the velocity of the heated gases increases. To insure relatively constant high velocity throughout, Preferred *reduces gas passage area* to compensate for decreased gas volume. High gas velocity through the greater length results in high resistance to gas flow assuring even distribution of the gases, cleaner heat transfer surfaces with less tube cleaning, and lowered stack temperatures *year after year.***

Hundreds of plant engineers and consulting engineers readily admit that you can buy cheaper unit steam generators but the general consensus of opinion is—*you can't buy anything better than a Preferred!*

For all the facts, write today for your free copy of Bulletin 2000 . . . see for yourself just how Preferred is different and why it's a better buy.

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You may be doing just that if your plans don't include CHLORINATION EQUIPMENT for slime control by WALLACE & TIERNAN.

Chlorination equipment because it controls slime that *grows* on the walls of condenser tubes not protected against it. Enough of the growth eventually seriously reduces heat transfer efficiency — actually *insulates* your steam from the cooling water. Back pressures go up, production drops, operating and maintenance costs rise, and eventual shut-down becomes necessary for regular clean-out periods.

Wallace & Tiernan equipment because it is versatile, sturdy and dependable — proven by thousands of successful installations, vouched for by satisfied users everywhere-and because there's a Wallace & Tiernan chlorinator for every job. Write today for information on how Wallace & Tiernan chlorination may help you solve *your* slime problem.

NO WATER IS SLIME-FREE

regardless of the source. Chlorination helps reduce slime in make-up or cooling water.

CD-37

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COMPANY, INC.
CHLORINE AND CHEMICAL CONTROL EQUIPMENT
NEWARK 1, NEW JERSEY • REPRESENTED IN PRINCIPAL CITIES

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(Continued from page 113)

output of 32,500,000 kwh, the maintenance cost is only $7,000 per year. The corresponding curve for the steam plant indicates a constantly increasing maintenance cost with the increase in plant output, which would be expected.

Maintenance and Operation

Maintenance cost of oil engine plants apparently increases with a reduction of plant output because less operating labor is required at the lower loads and the labor thus released from operating duties is used on maintenance work. At least there may be a tendency to charge the time of the operating personnel to maintenance when such labor is free from operating duties. This is borne out by the shape of the curves giving the operating labor costs. The curve showing the operating labor cost for the oil engine plant declines very rapidly while the same curve for the steam turbine plant shows little tendency to drop at the low outputs.

Thus the curves showing the cost of maintenance and operating labor for oil engine plants do not necessarily give a true picture of the relative cost of these two items. This situation does not exist to as great an extent in the steam turbine plants because steam equipment, especially the boiler equipment, requires the attention of the operators even at zero load if the plant is to be available for emergency or peak load service.

Curves in Fig. 3 show a tendency to dip downward toward the zero point and the dotted portion of these curves is based on the assumption that, theoretically at least, no expenses are incurred when an oil engine plant is out of service, although it may be considered to be in commission and available for quick starting when needed. On the other hand, the curves in Fig. 4 for the steam plants show no tendency to dip down toward the zero load point as is to be expected; and when these curves are extended to the zero output point, considerable expense still is incurred if the plant is to be kept hot and available for quick start-up in an emergency. Comparison of the curves in Figs. 3 and 4 illustrates the great advantage of oil engine plants over the small steam turbine plants for emergency service.

Figures 5 and 6 show the various expense items expressed as percentage of the total expenses and show the same marked differences in the two types of plants.

The Federal Power Commission's report mentioned above, from which the data for the small steam turbine plants were taken, also contains information for one natural gas turbine plant. This plant is new and was not in commission for the whole of 1951, having been placed in commission during February of that year. For this reason these data should not be considered conclusive. It is hoped

For complete satisfaction, install POWELL VALVES

To be completely satisfactory, a valve must function perfectly, give maximum length of service and require minimum maintenance. To do this it has to be exactly right—in design and materials—for all the conditions under which it must operate. And because Powell makes just such a valve for every service in modern industry, Powell Valves always give complete satisfaction.

The Wm. Powell Co., Cincinnati 22, Ohio

Fig. 800—125-pound Bronze Gate Valve with screwed-in bonnet, inside screw rising stem and tapered wedge.

Fig. 1793—125-pound Iron Body Bronze Mounted Gate Valve with tapered solid wedge. Made in sizes 2" to 30", inclusive.

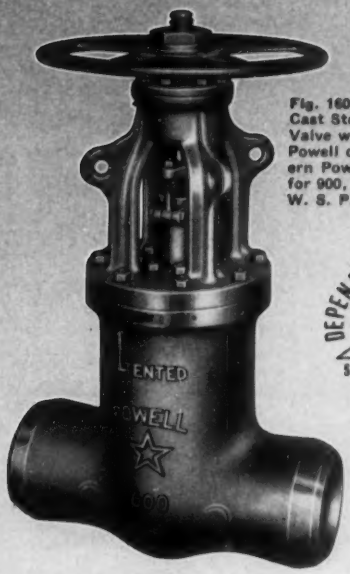


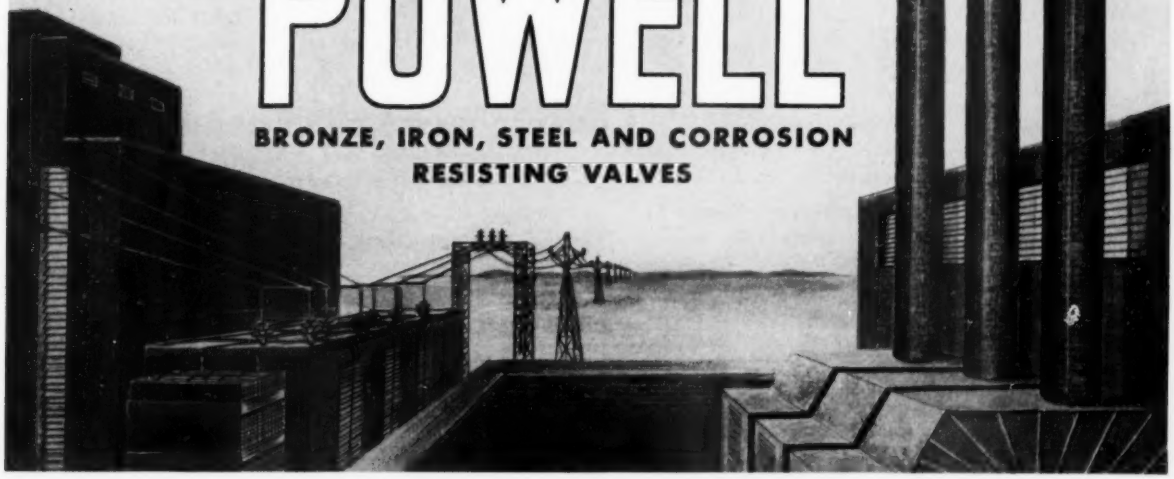
Fig. 16003 W. E.—600-pound Cast Steel Pressure Seal Gate Valve with welding ends. A Powell design for the modern Power Plant. Also made for 900, 1500 and 2500 pounds W. S. P.

DEPENDABLE VALVES SINCE 1846

Fig. 3031 W. E.—300-pound Cast Steel Globe Valve with welding ends, bolted flanged yoke and outside screw stem.

POWELL

BRONZE, IRON, STEEL AND CORROSION RESISTING VALVES



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- *Softening*
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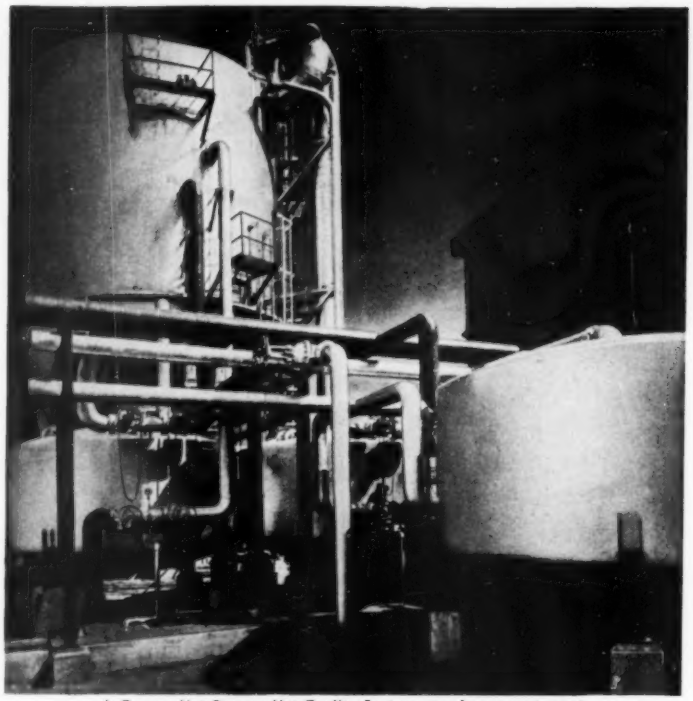

A Graver Hot Process-Hot Zeolite System at a large west coast cooperative steam-producing plant.

Easily the most versatile equipment available to the boiler plant engineer today to treat his feedwater is the Graver Hot Process-Hot Zeolite plant. This system can achieve all or any of these results, usually at most economical cost.

Heating and deaeration can be accomplished in the first stage hot process unit with complete deaeration of oxygen to 0.005 ml/liter whenever required.

Clarification of turbid raw water supplies can be obtained in this stage as can alkalinity, dissolved solids and organic matter reduction. Iron and manganese are also removed here.

By adsorption in the first stage with inexpensive magnesium precipitates, silica can be reduced to less than 1 ppm in the treated water.

This plant utilizes resin zeolite which is selective to magnesium, assuring preferential magnesium reduction. This avoids magnesium phosphate boiler sludge —a troublesome product of the older type hot process-hot phosphate system.

A Graver Hot Process-Hot Zeolite plant assures *constant* zero hardness to the boiler *regardless* of the raw water hardness variation, chemical feed adjustment or load fluctuation.

Many Graver installations prove that this versatile system produces an extremely high quality feedwater for higher pressure boilers at economical operating costs.

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EQUIPMENT FOR ALL WATER AND WASTE TREATMENT PROCESSES

Hot Process-Hot Zeolite Softeners

GW478

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that as more gas turbine plants are placed in commission the performance of these plants will be published.

Table II compares the gas turbine plant with oil engine and small steam turbine plants. Plant factor of the gas turbine plant for the time it was in commission was 20.6 per cent. The first seven items in this table for all three types of plants are based on a plant factor of 20.6 per cent for the purpose of comparison, data for the oil and steam plants being taken from Figs. 1 and 2. Information given in the remaining items is based on averages of all load conditions.

New ENGINEERING BOOKS

Handbook of Engineering Fundamentals, Ovid W Eshbach, editor. Second edition. 8½ by 5½ in., 1324 pages, illustrated. Cloth. John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y. 1952. Price $10.00.

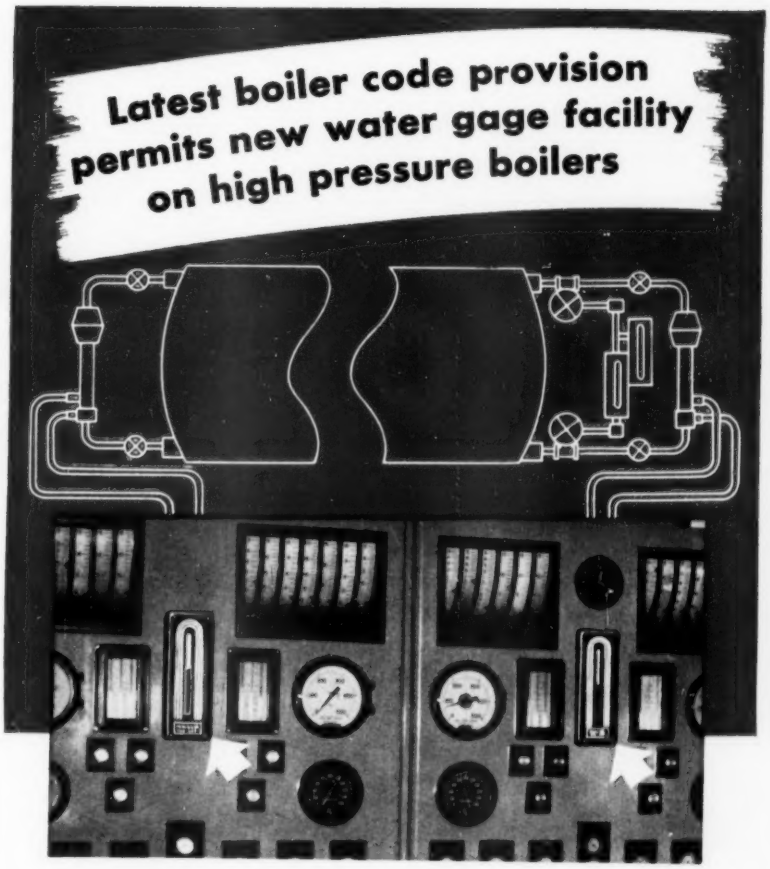
This companion volume to the specialized handbooks of the "Wiley Engineering Handbook Series" contains the fundamental laws, theories, and data which are basic to engineering practice. Since the appearance of the first edition in 1936, many new developments and changes in emphasis in various branches of technology have taken place and so this new edition has been completely revised. The discussions on mathematics, thermodynamics, and fluid mechanics have been entirely rewritten or revised. Similar treatment has been given the sections on electricity and magnetism, engineering materials, and engineering law. A new section on aerodynamic stress theory, basic to the design and performance of aircraft, has been included.

The engineering tables now include standard structural sizes for aluminum, as well as data on tangents and offsets for the use of civil engineers. At the same time the table on standards and symbols has been brought up to date, and new tables added for surveyors. The MKS system of units not only has been incorporated into the table of conversion factors, but receives greater emphasis throughout the entire edition.

★ ★ ★

Analysis of Alternating-Current Circuits, by W. R. LePage. First Edition; 444 pages; 6 by 9 in; illustrated; cloth. McGraw-Hill Book Company, Inc., 330 West 42nd St., New York, N. Y. 1952. Price $6.50.

This book on alternating current circuits is the outgrowth of the author's experience in teaching the subject in college. As he explains in the preface his goal always has been to impart understanding



Now two EYE-HYE Remote Gages give you the required double check on pressures 900 lbs and over

Two independent remote level indicators of the compensated manometric type may now be used instead of one of two gage glasses required on pressures 900 psi and over. You still must have one conventional type gage, maintained in serviceable condition, but it may be shut off while both remote indicators are in operation.

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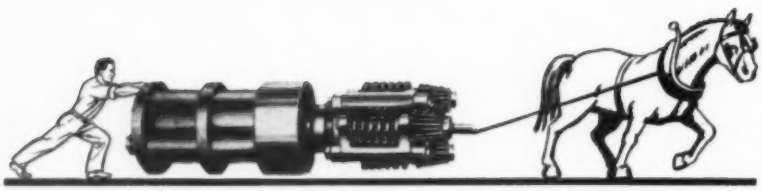

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of fundamental principles to the student, rather than merely have him acquire a dexterity in working problems. In successive mimeographed editions of the book the language has been simplified and extraneous discussion has been removed as much as possible. Mathematics, of course, is a necessity in a course in alternating current, but the mathematics is quite simple, being little more than trigonometry, algebra, and a bit of calculus. In many instances the exercise problems are drawn from devices which the reader is likely to meet in his everyday life.

Much attention has been given to the problem of communication between the author and the reader. To this end, an attempt has been made to state definitions clearly and to adhere to them rigidly. An attempt also has been made to keep the development logical and to have the technical level rise gradually with progress through the book.

An idea of the scope of the book may be had from a listing of the chapter titles. These are as follows: Alternating-current Systems; Introductory concepts; Metering and Effective Value; Symbolic Treatment of Sinusoids; Basic Integro-differential Equations; Sinusoidal Excitations; Power; Application of Complex Quantities; Network Terminology, Analysis of Networks; Magnetic coupling; Polyphase systems, Variable response networks; Nonsinusoidal Periodic Waves; Fourier series.

The author is Professor of Electrical Engineering at Syracuse University.

★ ★ ★

Metallurgy for Engineers, Casting, Welding, and Working. By John Wulff, Howard F. Taylor and Amos J. Shaler. Size 5½ by 8½ in.; 624 pp, including index and appendix; illustrated; cloth bound. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Price $6.75.

The main objective of this book is to help the reader acquire an adequate understanding of metals so that he may intelligently select and use them. Although the book is written primarily as a textbook for engineering students, it can also serve as a self-teaching book for practicing engineers who graduated in pre-World War II years when metals and their fabrication were less in the academic spotlight than they are today.

The first half of the book explains the concepts and principles that underlie metal processing from ingots to finished articles of commerce. The second half deals with the processes themselves.

Several chapter headings are listed to give an idea of the contents: Crystalline structure and properties of metals; Heat treatment of steel; Electrical and magnetic properties of metals; Corrosion; Casting processes; Powder metallurgy; and various welding processes.

The practicing engineer may refresh in his mind the concepts of metallurgical engineering which may have escaped his memory. To help carry out this objective, the text

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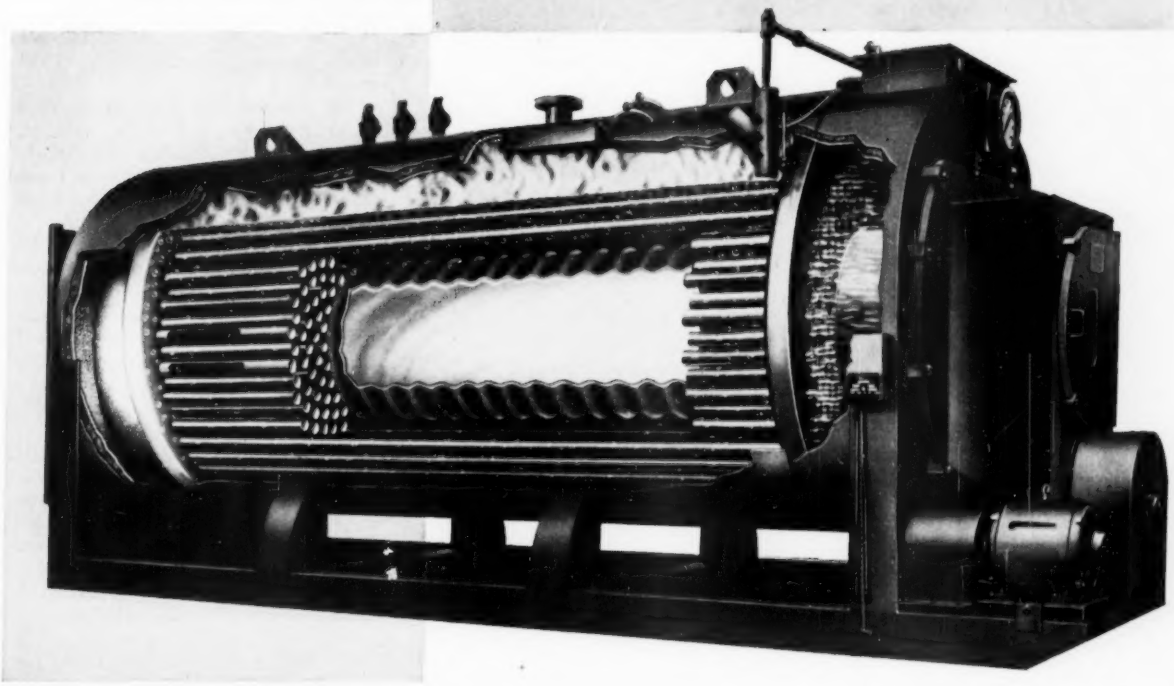

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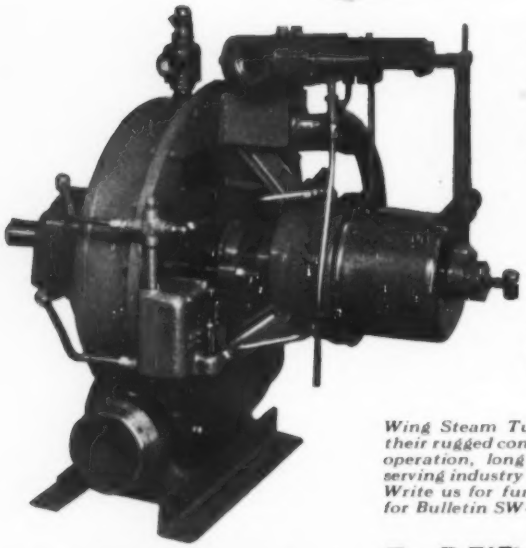

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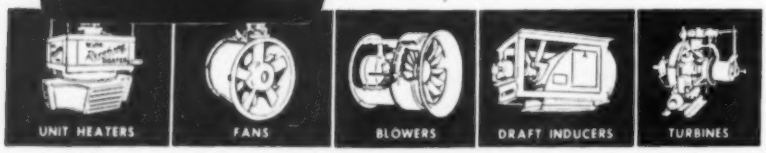

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tries to integrate, with the old, the concepts developed in more recent years.

★ ★ ★

Crane and Hoist Engineering by "Shaw-Box." Size 8½ by 11 in.; 160 pp including index; illustrated; cloth bound. Published by Manning, Maxwell & Moore, Incorporated, Muskegon, Michigan. Price $3.50 postpaid.

This reference book has been compiled by the engineering staff of the Shaw-Box Div. of Manning, Maxwell & Moore Inc. It contains authoritative information on crane engineering, design and application of cranes.

Illustrated are many kinds of cranes by means of vivid blue print type diagrams with a brief descriptive comment under each. Several pages throughout the book are devoted to outline dimensions of the types of cranes most frequently used by industry. These pertain to "Shaw-Box" cranes; however, they closely compare to crane outline dimensions of other design.

Sufficient crane engineering data is presented to properly design a crane and the runway to carry it. One very useful section of the book covers the inquiry data which should accompany the specifications submitted by the engineer to the manufacturer. A portion is given to typical specifications and tips on how to evaluate proposals.

★ ★ ★

EEI — NEMA Standard for Distribution Transformers, Overhead type, 5th Report; 32 pages; illustrated; size 8½ by 11 in; paper binding. Published by Edison Electric Institute, 420 Lexington Avenue, New York. Price $1.00 in U. S. A., $1.20 foreign.

This 5th Report of the joint committee of the EEI and NEMA contains design standards for certain mechanical and electrical features of overhead type single and three phase distribution transformers, rated 500-kva and smaller; high voltage 67,000 volts and below; low voltage 15,000 volts and below.

(*Continued on page 136*)

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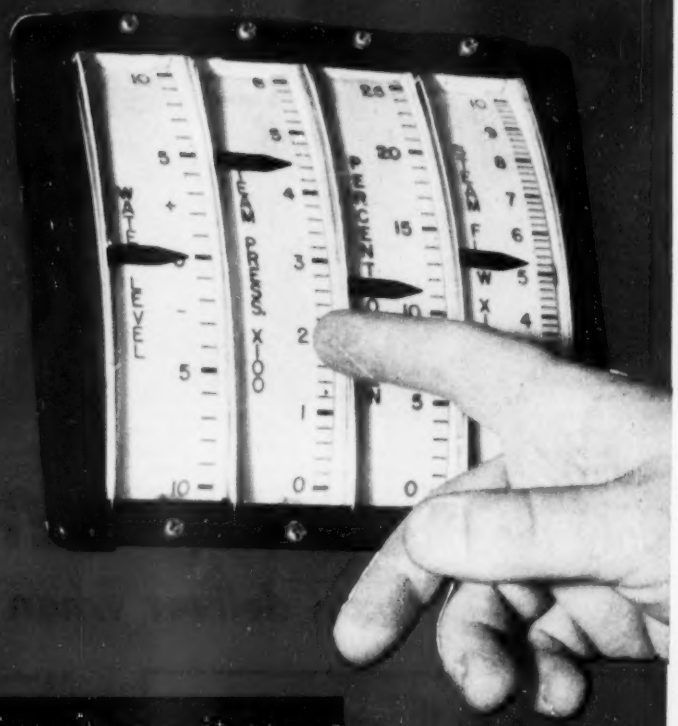

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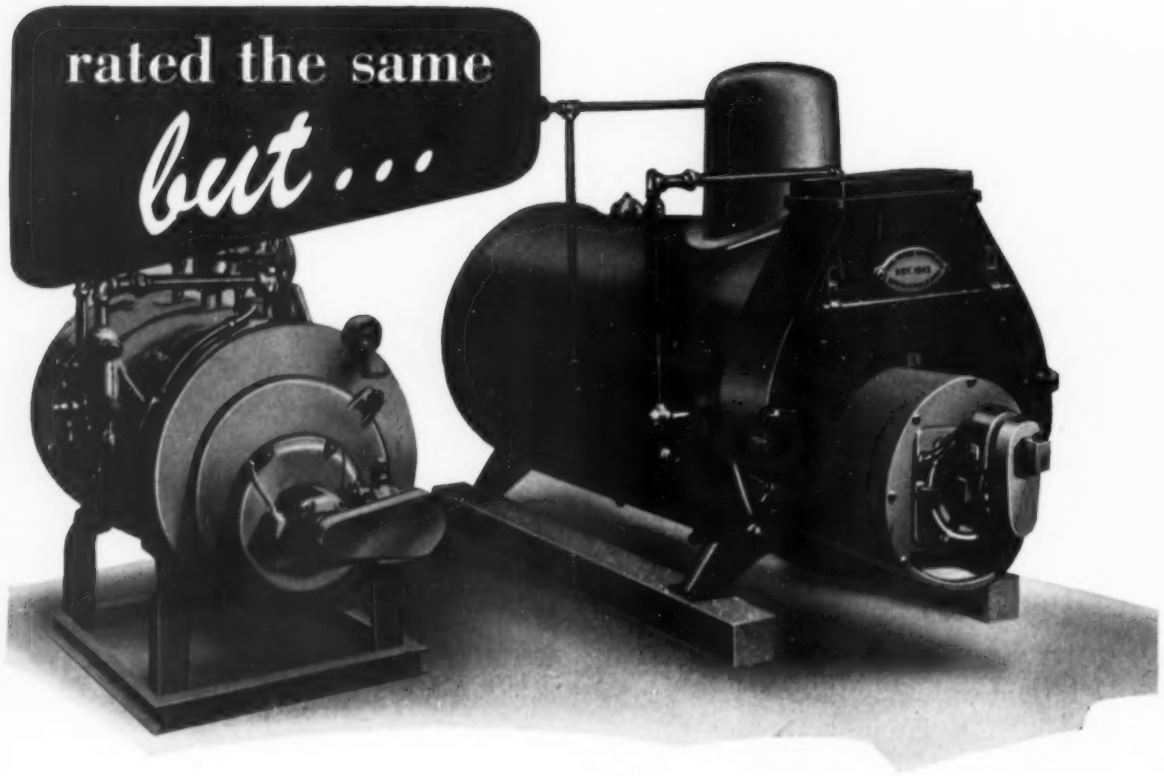

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HELPFUL BULLETINS

(Continued from page 88)

127 Needle Valves — Catalog NV-1, 8 pp, describes valves for the fine regulation of water, oil, gas, and other fluids. Text covering the development of these valves is illustrated by cutaways showing one-piece construction, other design features. Globe and angle types are illustrated, and sizes given for these throttling and shutoff needle valves of 10,000 psi maximum working pressure. Pressure drop chart is included. Marsh Instrument Co.

128 Precision Oil Valve — A valve designed to stop "guesstimating" in controlling the flow of oil to oil burners is presented in Catalog 707A, 4 pp. Tells how this valve acts to save time, oil and spoilage; explains manual and automatic operation. Stresses use with any grade of oil, other advantages. Hauck Mfg. Co.

129 Internal Downflow Purifier — Bulletin 401 describes company's internal downflow Hi-eF purifier for steam drums, flash tanks, evaporators, stills. Explains operation and advantages of the purifier; gives dimensions, weights and specifications. Also provides a selection table to aid in the choice of purifiers for any installation. The V. D. Anderson Co.

130 Welded Floats — Bulletin 753, 8 pp, describes welded floats of stainless steel, Monel, and chrome plated steel, in spherical, elliptical and cylindrical shapes. Gives data on weights, buoyancies and collapsing pressures, also includes prices. W. H. Nicholson & Co.

TOOLS

131 Hydraulic Pullers — Industrial maintenance problems involving the removal and installation of gears, bearings, pulleys, sheaves, pinions, shafts, couplings, and tubes are treated in Power-Twin Bulletin HY-1953, 24 pp. Covers use and application of pullers, attachments and adaptors for 17½-, 30- and 50-t hydraulic rams. Owatonna Tool Co.

132 Valve Reseating Tools — Bulletin describes Rex reseating tools designed for use in valves without removing them from the line. Several sets are listed, with valve sizes ranging from ¾ in. to 4 in. All parts are described, their uses explained, and a complete price listing is offered. Reseating tools are also usable for reseating reciprocal pump seats without removal. Deady Chemical Co.

DEAERATION

133 Deaerating Heaters — Bulletin WC-101A, 8 pp, covers spray-type deaerating heaters, stressing their importance as boiler safeguards. Explains operation of these heaters to show how they provide effective deaeration. Illustrated by photos and drawings of both vertical and horizontal models, text discusses first- and second-stage heater sections, performance results, and applications. Equipment utilized in the spray-type heaters is described briefly. Graver Water Conditioning Co.

134 Boiler Feed Water Deaeration — Eight-pp Bulletin 575 shows how company's Zero-Oxygen deaerators, capable of oxygen removal down to 0.005 cc/liter, offer efficient and economical deaeration for small and medium-size boiler plants. Explains how it operates, stresses low operating and maintenance costs, other advantages. Component parts of the equipment and their contribution to its efficiency are pictured and described. Fred H. Schaub Engineering Co.

135 Jet Tray Deaerator — Bulletin 28R7980 gives construction features of a deaerator offering the combined advantages of a spray-type, direct-contact, first-stage heater performing as a direct contact vent condenser and primary deaerating mechanism, a second-stage jet atomizer, and a final tray-type deaeration section with reboiling action. Tells how this deaerator is used in industrial power plants to remove corrosive gases from boiler feed water. Allis-Chalmers Mfg. Co.

OTHER EQUIPMENT

136 Mechanical-Drive Gas Turbines — Booklet No. B-5859, 24 pp, on combustion gas turbine power plants for mechanical drive applications, points out their uses for natural gas transmission, and in the chemical, refinery, steel mill, and other process industries. Describes four types: 1800-hp simple open-cycle; 5000-hp compound open-cycle with regenerator; 5300-hp compound open-cycle; and 7000-hp simple open-cycle. Load diagrams, dimensioned outline drawings, performance curves, and colored cut-away drawings are presented for each type. Westinghouse Electric Corp.

137 Modern Materials Handling — New methods in bulk handling are pictorially described in this 12-pp brochure. Versatility and flexibility of equipment in operation above or under ground is illustrated by "on the job" pictures. The importance of releasing manpower for productive work by mechanizing materials handling is stressed. Capacity, horsepower, weights and other data on equipment and attachments are included. Tractor Div., Allis-Chalmers Mfg. Co.

138 V-Type Engines — Eight-pp Bulletin 197 gives construction and operating data on company's four-cycle Supairthermal V-type engines, designed to meet the need for a high-powered heavy duty diesel, dual fuel or spark-fired gas engine of moderate weight and small dimension. Describes features of these 2400- to 4260-hp engines, gives ratings of both 12- and 16-cylinder models. Illustrates compact arrangement. Nordberg Mfg. Co.

139 Complete Combustion System — This bulletin describes seven complete combustion systems in metropolitan New York. Includes "before and after" pictures of installations at Astor Hotel, West Point Military Academy, Gimbel Bros. Peabody Engineering Corp.

140 For Industrial Filtration — Bulletin A-943, 8 pp, gives essential features and applications of manufacturer's 10 basic types of industrial filtration equipment . . . filters, flotation units, vacuum stills, magnetic separators, and oil conditioners. Covers equipment designed to reclaim and repurify oils, coolants, solvents and industrial waters by removing solids, solubles and volatile contaminants. Industrial Filtration Div., U. S. Hoffman Machinery Corp.

141 Oil Burners — This condensed 16-pp catalog lists commercial and industrial oil and combination gas-oil burners. These include fully- and semi-automatic and manually controlled horizontal rotary and steam turbine drive burners, and pressure atomizing types for oil, gas or combination gas-oil. Ray Oil Burner Co.

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THIS MONTHLY list of standard catalogs and bulletins is published to help power engineers maintain a permanent catalog file of engineering data. The items listed, unlike those under Helpful Bulletins, may appear each month except for additions and deletions determined by space requirements or by the manufacturers issuing the catalogs and bulletins. Use the postage-free card below for your request

WATER CONDITIONING

201 What's What on Ion Exchangers — Here are three booklets on ion exchangers: Nalcite HCR, a styrene type cation exchanger; Nalcite SAR, a strongly basic anion exchanger; and Super Nalcolite, a synthetic gel type zeolite for cation exchange. Tables and graphs explain performance of these water treating resins under various operating conditions. Physical characteristics, exchange capacities, regeneration techniques dicussed. Bulletin 57, 20 pp, is on Nalcite SAR; Bulletin 58, 28 pp, Nalcite HCR; Bulletin 59, 8 pp, Super Nalcolite. State those wanted. National Aluminate Corp.

202 Modern pH and Chlorine Control — This 100-pp booklet gives details in color comparators and equipment in water testing and control of boiler and industrial process water, also technical information on meaning of pH control, electrometric and colorimetric methods of determining pH and impurities in water; applications of water control in air conditioning; feedwater. W. A. Taylor & Co.

203 Steam System Treatment — This bulletin on Coravol for prevention of corrosion, explains theory of corrosion, application of organic amines to steam systems (the Coravol process) and presents case histories of use in different types of plants and industries. Coravol is part of a complete technical service providing special chemical formulas for treatment of water, steam, brine and fuel. Western Chemical Co.

204 Boiler Scale — Formation and Prevention — Technical Paper 98 is a 12-pp article covering the cause and prevention of boiler scale. Covers the mechanism of scale formation, effect of boiler scale, chemistry of scale formation, internal chemical treatment and chemical correctives. Diagrams of feeder systems, photos and solubility charts illustrate text. W. H. & L. D. Betz.

205 Water Conditioning Data Book — Recently revised, this pocket-size 116-pp booklet presents a compilation of 77 tables, all valuable to the power engineer. Covers such subjects as hydraulics, impurities in water, boiler feedwater makeup requirements, chemical conversions and chemical reactions. Contains excellent reference information on many phases and methods of water treatment. Available without charge to qualified power engineers. The Permutit Co.

206 Data on Zeolite Softeners — Publication 4520-A is a 32-pp well illustrated booklet on zeolite water softening. Provides a glossary of terms used in the process, data for laying out a zeolite softening plant, factors governing size of equipment, selection of Zeolite materials and discussion of the operating stages of a sodium zeolite softener. Cochrane Corp.

207 Corrosion Treatment — "Corrosion Protection of Steam and Condensate Return Systems" is a folder on amine treatment for boiler and condensate systems. This treatment is described as affording surface protection of the metal as well as raising pH value of condensate. The Bird-Archer Co.

208 Treatment by Ion Exchange — Methods of ion exchange treatment and its general and special applications for water and other liquids are explained in 8-pp Bulletin A. Discusses manufacturers' deionizing equipment as to construction and operation, pictures applications. Illinois Water Treatment Co.

210 Water Conditioning Bulletin — This is an 8-pp discussion of water and the chemicals developed for conditioning it to control scale and algae and inhibit corrosion. Describes several chemicals in detail, giving properties, composition. Wright Chemical Corp.

211 Boiler Water Manual — Factual information on methods of applying chemicals in treatment of water for boilers is presented in 16-pp Standard Method 122. Discusses pretreatment of raw water, application of chemical feeding to pretreating operations and both constant rate and flow responsive feeding direct to boiler drum and feedwater system, condensate returns. % Proportioneers, Inc. %

212 Water Treatment — Bulletin 5000, 24 pp, explains the reasons for boiler water treatment and tells services offered by company in providing formulations for individual plant requirements. Covers pretreatment, internal treatment, treatment application, blow-down adjustment, test control. Describes equipment. Dearborn Chemical Co.

213 Feedwater Treatment — Here is a 10-pp illustrated report on boiler feedwater treatment for a high-pressure, high-makeup power and steam producing plant. It is based on studies to determine best method of meeting requirements for both the high-pressure steam used in power generating turbines and the district heating steam for downtown Philadelphia. Graver Water Conditioning Co.

214 Microbiological Control — Technical Article 3C, 12 pp, is an illustrated discussion of microbiological control of and through industrial waters. A section on industrial water chlorination covers cooling waters and process waters. Other sections deal with chlorine metering in chemical processes, and the sanitary aspects of industrial water treatment. Wallace & Tiernan Co., Inc.

COAL, ASH HANDLING

215 Economic Coal Storage — How tractors establish safe, orderly coal handling is told in this 8-pp booklet. Stresses flexibility, low operating costs. Also shows how tractors speed storage reclamation and how a tractor-scraper combination

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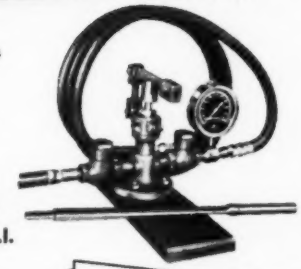

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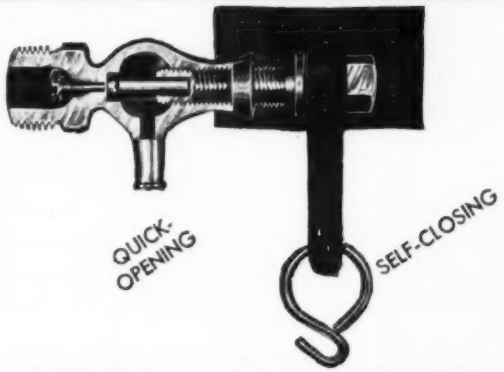

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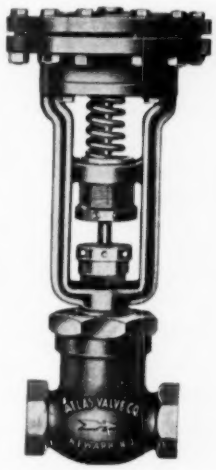
The exceptional valve shown here is our ATLAS Type "D". In our 52-page Bulletin 1-A it is shown as Fig. 171. If you need reducing valves be sure to ask for Bulletin 1-A as it gives complete information concerning a wide range of regulating valves for steam, water, air, gas or oil. Ever since its introduction Type "D" has made a "hit" with engineers. It is unusually simple. Gives accurate and close regulation of pressures. Is easy to inspect. Stainless steel or bronze seat rings, stainless steel or composition discs. Stainless steel valve stem. Removable diaphragm top. Adaptable to steam, air, or gas. Good for up to 300 lb. initial pressure. Durable. Body of bronze. Screwed or flanged ends.



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● You can cool air, gas, water, oils, chemicals, electric and power and process equipment, engines, mechanical processes with lower cost and really accurate control of temperature with the Niagara Aero Heat Exchanger.

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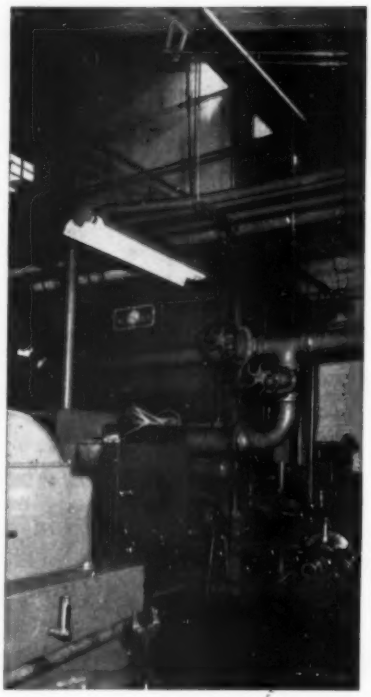

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offers plus benefits. Illustrated with action photos; pictures several models. Tractor Div., Allis-Chalmers Mfg. Co.

216 Where Refuse Is Fuel — Presented in 24-pp Bulletin are installations of company's stokers with medium-size and larger units burning refuse fuels, separately or in combination with coal. Lists many of the refuse fuels handled successfully by this type of spreader stoker. Detroit Stoker Co.

217 Spreader Stoker Data — This is a file of three illustrated bulletins on spreader stokers. The first discusses seven reasons for selecting these stokers and describes their design, construction and operation; the second, dumping grates, the third, installations. Riley Stoker Corp.

218 Spreader Stoker Selection — Fourteen-pp Form F-520-A10M is intended to help those choosing a spreader stoker to get the most for their investment, and it points out many factors to be considered. American Engineering Co.

219 Shredder Ring Crusher — A crusher for coal and similar materials which features rolling shredder rings is described in this 8-pp bulletin. Gives details on a survey of 29 mines and power plants in which this type crusher is installed. Informative tables giving speed, capacity, horsepower, weight and dimensions of crushers, as well as cost data are included. American Pulverizer Co.

220 Automatic Coal Scale — Sixteen-pp Bulletin 0352 describes an automatic coal scale for weighing coal as it is fed to boilers, enabling a power engineer to maintain a constant check on boiler efficiency. Book gives construction and operating details on the belt feeder, weigh hopper, scale housing, operating levers and accessories. Photos and line drawings show scale features. Richardson Scale Co.

FUEL OILS, LUBRICANTS

221 Air Compressor Lubrication Manual — Valuable information on air compressor maintenance is contained in this 40-pp book. Subjects treated include compressed air, compressors and related equipment, lubricating systems, compressor oils and applications, lubrication requirements, operating hints, oil requirements, storage and care of compressor oils, also safety precautions. Cities Service Petroleum, Inc.

222 Diesels, Their Fuels and Lubricants — This 46-pp book gives practical information on diesel engines, covering their history and economics as well as design characteristics and operating principles. Classification of diesels according to speed is covered. Sinclair Refining Co.

223 Versatile Industrial Oil — Described in 20-pp Form AD 4078 is an all-purpose oil offering protection for a wide range of industrial equipment, and available in 15 viscosity grades. Discusses six major characteristics of the oil; explains and pictures its use in hydraulic systems, speed reducers, air compressors, electric motors, hydraulic turbines, bearing systems, etc. A chart shows grades available, their uses and physical properties. Standard Oil Co. (Ind.)

224 Turbine Lubrication — The special problems of turbine lubrication are discussed in 8-pp Bulletin TU-1. Tells how purifiers keep power units in service; discusses inhibited and uninhibited oils, com-

pany's process for reducing sludge formation within lubrication system. Illustrated with diagrams of typical installations, photos of purifiers. DeLaval Separator Co.

225 Turbine Oil Conditioning — Bulletin 832-P, 12 pp, offers a detailed explanation of the reasons for turbine oil conditioning, the way in which company's dry type conditioning equipment nullifies or prevents factors which promote deterioration of oil. Bowser, Inc.

BOILERS, GENERATORS

226 Improved Steam Generator — Bulletin 2000, 28 pp, explains advance design features that distinguish this manufacturer's generator from other unit steam generators. Describes and illustrates engineering differences of component features. Also shows how these components are constructed, assembled and tested. Another section gives data, and dimensions and standard and accessory equipment for the units which range from 20 to 6000 hp, for pressures to 250 psi. Preferred Utilities Mfg. Corp.

227 Shop-Assembled Boiler — Sixteen-pp Bulletin G-76, completely describes and illustrates company's Type FM water-tube integral-furnace boiler, made in standard sizes from 2900 to 28,000 lb of steam per hr, pressure to 250 psi. Savings in erection, installation and moving costs are stressed. Capacities, dimensions given. The Babcock & Wilcox Co.

228 Re-circulation Steam Generator — Here's a 6-pp folder on a controlled re-circulation steam generator, describing its development and uses, such as applications where steam is required in remote locations, where demands are intermittent, or where load fluctuates. Combustion Engineering, Inc.

229 Scotch Marine Boilers — Bulletin 236 illustrates and describes a Scotch type of boiler on skids suggested for a wide range of applications. This boiler can be hand- or stoker-fired with coal or can use oil, gas or wood as fuel. Gives construction details, stresses versatility, other advantages. Includes test data and specifications. The James Leffel & Co.

Postage-free cards for ordering catalogs and bulletins are provided on pages 37 and 124

230 Steam Boilers — Form SG 128-749 is a 12 pp catalog illustrated with photos of steam boilers for processing and heating, ranging from 15 to 500 hp and 15 to 200 psi. Includes diagrammatic cross-section of four-pass design characteristic of company's boilers. Cleaver-Brooks Co.

231 Oil or Gas Fired Automatic Boilers — Boiler, burner, controls and safety features of 10 to 500 hp oil or gas fired automatic boilers are described in this bulletin. Firing rates, dimensions and capacities are given for all models along with installation photos of some models. Boiler Engineering & Supply Co.

232 Steam Generators — Illustrated Bulletin SB43, 20 pp, describes company's

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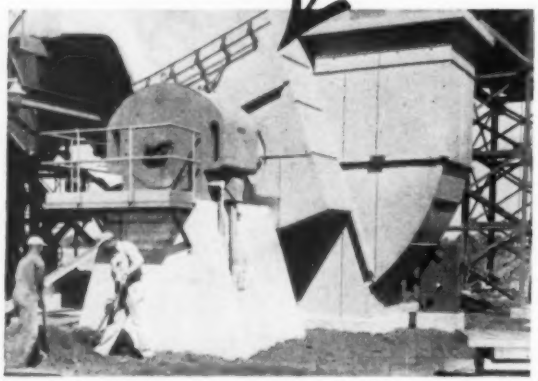

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VL factory assembled generators combining 2-drum water-tube boiler, integral water cooled furnace, brick work, insulation and steel casing. A large cutaway illustration shows design details, and gas travel. Use of generator with various fuels and firing arrangements is covered. Erie City Iron Works.

HEAT EXCHANGING, COOLING

233 Heat Exchangers — The advantages of film-type heat exchangers in the solution of cooling water problems, even when dirty water must be used, are stressed in Bulletin HE-7, 8 pp. Explains and illustrates design details. Discusses use of these heat exchangers in power plants, chemical plants, and in a compression plant. Henry Vogt Machine Co.

234 Finned Tube Heat Exchanger — Bulletin 1400, 20 pp, fully describes the company's G-R Twin G-Fin Section heat exchanger. The unit has wide application for heating and cooling liquids and gases, and for condensing vapors, according to the company. Suitable as boiler feedwater preheaters, fuel oil heaters, etc., features of design and construction are given. Griscom-Russell Co.

235 Heat Exchanger — Bulletin 114, a small folder, gives concise information on company's Aero heat exchanger with balanced wet bulb control designed to cool engines or process equipment, coolants and lubricants, liquids and gases for processing operations. Niagara Blower Co.

236 Cooling Towers — Bulletin AQ-50 is on packaged water cooling towers in 3 to 50 t sizes. Gives specifications for the tower and discusses special features. Also provides dimensional and application data. The Marley Co., Inc.

TUBING AND ACCESSORIES

237 Condenser Tubes — Excellent information on condenser tubes and their service life is given in this 40-pp illustrated booklet. Subjects discussed include corrosion of condenser and heat exchanger tubes, corrosion resistance and control, the selection of tube materials, and the composition and physical properties of company's alloys. Details on proper installation are presented, as are specifications, conversion tables, weights of tubes and alloys. Scovill Mfg. Co.

238 Life Extension for Condenser Tubes — This 32-pp extensively illustrated booklet reports on research into the causes of corrosion and means of combating them, as well as the choice of condenser tube materials. Points out that Admiralty metal, long a standard for power plant condenser tubes, works satisfactorily in most installations, but other alloys may be necessary in some circumstances. Revere Copper and Brass, Inc.

239 Nickel Pipe and Tubes — Bulletin T-17 is a 27-pp technical bulletin on the fabrication and design of nickel and high nickel alloy pipe and tubing, illustrated throughout by drawings and photos. Presents tables on mechanical and physical properties, ASME code requirements, recommended welding procedures. The International Nickel Co., Inc.

240 Double-Walled Tubing — Technical Bulletin 1950, 12 pp, presents tubing designed for conditions where single-walled tube can't withstand simultaneous attack from two types of corrosive media. Describes and illustrates construction, illus-

trating possible metal combinations. Explains tubing's use in ammonia refrigeration, boilers, steam generators. Discusses heat transfer properties, high temperature use. Bridgeport Brass Co.

241 Tube Cleaners — Catalog 76-A provides 48-pp of information on manufacturer's line of tube cleaners. Following equipment selection and operating hints, this practical catalog describes and pictures cutter heads and drill heads, brushes, and motors, giving sizes, application information. Electrically driven equipment, air valves, hose, lubricators presented. Thomas C. Wilson, Inc.

242 Rotary Tube Cleaners — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads discussing special features. Roto Div., Elliott Co.

243 To Avoid Tube Corrosion — Bulletin TR-514 is an 8-pp illustrated article discussing corrosion as a major factor in shortening the life of boiler tubes. Indicates that, in low pressure boilers, corrosion is the largest single cause for replacement of tubes. Points out types and causes of corrosion and gives general rules to follow to get maximum service life from boiler tubing. Tubular Products Div., The Babcock & Wilcox Co.

GAS AND OIL BURNERS

244 Gas Burners — Illustrated Bulletin 410-8, 16 pp, furnishes descriptive and technical data on company's gas burners and combination gas and oil burners, giving design details and explaining operation of each. Coppus Engineering Corp.

245 Oil Burning Equipment — Bulletin O-B 37 contains 16 pp of technical information on company's oil and gas burning equipment, steam atomizing burners, mechanical atomizing burners, interchangeable burners, telling best applications, including capacity data. Also shows fuel oil pumping, heating systems. The Engineer Co.

246 Steam Atomizing Oil Burners — Sixteen-pp illustrated Bulletin 21 describes steam atomizing oil burners and auxiliary equipment for use with heavy oil or tar in boilers, stills, dryers and other furnaces, where steam or compressed air is available for atomizing the oil. National Airoil Burner Co., Inc.

REFRACTORIES, INSULATION

247 Refractory Cements — Sixteen-pp Form 863, presenting a line of refractory cements, discusses the three basic materials used in them, provides a detailed selection guide and illustrated discussion on methods of preparation and installation. Also defines terminology. Norton Co.

248 Heat Insulation Data — This is a 12-pp illustrated engineering and specification manual describing applications for 85 per cent Magnesia heat insulation. Provides data on heat savings per pipe thickness, for heat ranges to 600 F. Includes charts for determining thickness standards for pipe covering, with tables for heat calculations. Mundet Cork Corp.

INSTRUMENTS AND CONTROLS

249 Supervisory Instruments — Catalog 90-2. "Supervisory Instruments for Power Generation," consists of 41 pp on the instrumentation involved in gen-

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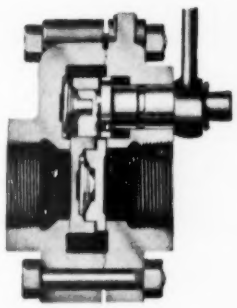

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erating stations. Separate sections cover steam generation instrumentation, turbine and generator instrumentation, electrical distribution instrumentation and diesel engine instrumentation. Measurement of temperature, pressure, flow, power generation and other variables discussed. Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

250 **Easy Reading Gage** — An all-hydrostatic remote reading gage for boiler water and other liquid levels is described in Catalog 500, Section CO. Pictures improved visibility, other advantages offered by this gage, explains operation. The Reliance Gauge Column Co.

251 **Industrial Thermometers** — Catalog 125, 28 pp, presents ordering data on a wide range of industrial thermometers, giving scale ranges, dimensions and prices. Features company's Adjust-Angle thermometer designed for use at any angle front to back, left or right, through a 180 deg arc. Gives construction details and advantages of this adjustable-stem type instrument. Weksler Thermometer Corp.

252 **Sight Glass Flow Indicators** — Twelve-pp Bulletin 18-W, on company's line of flow indicators, shows how these mechanical devices indicate fluid flow and its direction in pipelines which can be directly observed through a sight glass and are suitable for service with liquid, gas, vapor, slurry or sludge sufficiently translucent to permit observation of indicating element. Schutte and Koerting Co.

253 **How to Select Regulators** — This 36-pp, illustrated "step selection chart" simplifies choice of proper type and size of pressure regulator, temperature regulator or pump governor to do a specific job. Written in nontechnical language and supplemented by steam, gas and water capacity tables, this booklet includes installation suggestions, conversion tables and other data. Foster Engineering Co.

254 **Steam Specialties** — Catalog 53, 62 pp, describes a line of steam, gas, air, oil and water regulating equipment. Includes complete specifications, operational data and prices on pressure regulators, temperature regulators, combination pressure-temperature instruments, diaphragm valves, motor operated valves, float valves, safety and relief valves, strainers, solenoid and motor valves, water gages. Provides capacity tables, flange charts. O. C. Keckley Co.

255 **Pneumatic Valve Operator** — This 8-pp bulletin explains operating principles and outstanding features of the Rotomotor positioning operator for throttling control service. Tells how this heavy duty, all-pneumatic operator is designed to combine safety and economy of air operation with the power of a gear driven screw stem. Conoflow Corp.

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256 **Electronic Control System** — Bulletin A-701 introduces company's Autronic system, a miniature all-electronic system for controlling pressure, temperature, flow and level, intended for use in chemical processing plants, refineries, central stations, other applications where fast, accurate control is required. The Swartwout Co.

257 **Electronic Feedwater Control** — Three systems for the electronic regulation of boiler feedwater are explained briefly and diagrammed in Bulletin 52-1073-221. They include a single-element, two-element, and three-element system. Applications for each type are told, and descriptions of the flow measuring, receiving, level measuring elements, power unit and valve are included. The Hays Corp.

258 **Instruments Control Systems** — Twelve-pp Catalog 513 presents manufacturer's line of instruments, control systems, regulating valves and desuperheaters. Covers draft and pressure instruments, boiler meters, recorders, thermometers, regulators, combustion controls, pump controls and many others. Republic Flow Meters Co.

259 **Boiler Control** — Ten-pp Bulletin 1007 describes a completely integrated system for controlling combustion, feedwater, boiler steam temperature and boiler cleaning, available in a single package or furnished separately. Illustrated with full

color drawing of complete control, photos of recorders, drive unit. Covers instrumentation with both miniature and standard instruments. Copes-Vulcan Div., Continental Foundry & Machine Co.

260 Control Centers — This 31-pp application booklet (B-5621) on control centers stresses the case for centralizing all controls of an entire system in one group of enclosures. Discusses the characteristics of control centers that make for flexibility of use, ease of servicing, safety. Three types are described, and the various electrical components that make up typical units are illustrated. A three-step building-block system of planning control centers is given. Westinghouse Electric Corp.

261 Control Equipment — Catalog 003, 32 pp, presents company's equipment for the control of liquids and gases for water and sewage works, power and process industries. A well illustrated booklet, it lists many types of controllers, gages, manometers, valves, venturi tubes. Descriptions of the units, their operating characteristics, construction details, mountings, specifications and other data included. Simplex Valve & Meter Co.

262 Metering and Control Equipment — Sixteen-pp Bulletin 18 is a comprehensive catalog offering information on company's meters, control equipment and engineering services. It is written for engineers in power plants, public utilities and process plants. Fifteen measured variables common to power and process operations form the index for selecting appropriate metering and control equipment. Basic specifications, and detailed literature references included. Bailey Meter Co.

263 Gage Cocks — Quick-opening and self-closing gage cocks in models designed for pressures up to 250 lb and 450 lb, and a wood wheel gage cock designed for pressures up to 150 lb are described in this illustrated folder. Explains construction, applications. The Paul B. Huyette Co., Inc.

264 Pressure Regulator — Bulletin 1-B, 8-pp, discusses design, operation and applications of a super-sensitive pressure regulator; shows typical installations. Also covers a compound regulator for back pressure relief valve. Atlas Valve Co.

ELECTRICAL

265 Electrical Maintenance Tips — Booklet B-5477, 28 pp, gives a complete outline of preventive electrical maintenance. Discusses general maintenance programs designed to reduce shutdown time and treats in detail the maintenance of power equipment. A suggested schedule of work and cleaning on power equipment is presented in chart form. Essential information on preventive maintenance for turbines, generators, switchboards, motors and controls is provided. Westinghouse Electric Corp.

266 Wire, Cable Ordering Guide — Newly-released General Catalog W-52-3, 186 pp, presents more than 500 different types of wires and cables. Contains comprehensive data on construction and operating characteristics for control and signal cables, cables for construction work, telephone wire and cables, and portable cords. A technical engineering data section is included. United States Rubber Co.

267 Power Distribution Practices — The 28-pp "Industrial Power Distribution Idea Book" (Bulletin GEA 5900) is a

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guide on electric power distribution practices in large and small plants. Covers utility distribution practices; methods of buying electric power; what to do when a choice of primary voltages is available; application of primary switches and circuit breakers; types and arrangements of primary cables; and types of load-center distribution systems. General Electric Co.

268 Motor-Generator Reference Book — Publication 51R7933 is a 50-pp booklet compiled to assist in the selection of motive power to handle most industrial applications. Neither text book nor ordering catalog, this book provides a brief outline of the various types of motors, generators and motor-generator sets, telling their applications and operating requirements. Booklet is generously illustrated and includes performance data, ratings, information on methods of speed control, general characteristics and representative dimensions. Allis-Chalmers Mfg. Co.

269 Insulation Temperature-Resistance — Technical Publication 21T4, 16 pp, is an article on temperature-resistance characteristics of electrical insulation. Complete with tables and graphs, gives general information on variations in temperature characteristics, composite nature of electrical insulation, and practicability of temperature compensation. Other chapters deal with determining insulation constants for temperature correction factors, dielectric absorption characteristics, and a practical method of obtaining insulation temperature. James G. Biddle Co.

VALVES, TRAPS, PIPING AND ACCESSORIES

270 Safety Valve Engineering Data — How company's safety valve works and its operating advantages are explained in Bulletin 707. Includes dimensions on valve types and tables on superheat correction factor. Manning, Maxwell & Moore, Inc.

271 Check Valves — Twenty-pp Catalog 30 presents company's line of tilting-disc check valves made in iron, bronze and steel for working pressures to 3000 psi. Explains operating principle of tilting disc construction, discusses closing without slam, reduced loss of head, other advantages. Includes construction details, sizes. The Chapman Valve Mfg. Co.

272 Valve Specialties — Included in 90-pp Catalog A-50 is ordering and engineering information on automatic pressure flow and liquid level controls for steam, air, gas, water, oil, other fluids. Sections are devoted to pressure regulators, altitude valve, pump governors and strainers; lever, float and motor operated valves; pilot valves; back pressure, relief and non-return valves, steam trap and air vent; liquid level controllers; solenoid valves. Davis Regulator Co.

273 For Quick Valve Selection — Here's a 20-pp catalog digest providing ordering and application information on gate, globe, angle and check valves in bronze, iron, cast and forged steel construction, also valve accessories and parts. Illustrated and indexed, includes pressure-temperature chart. The Ohio Injector Co.

274 General Service Valves — Bulletin E-160, 16 pp, describes and illustrates design and construction of company's quick-operating valves, explaining their application to blow-off service and on chemical process, soot blowers, water column blow-down, and other types of pipe line. Everlasting Valve Co.

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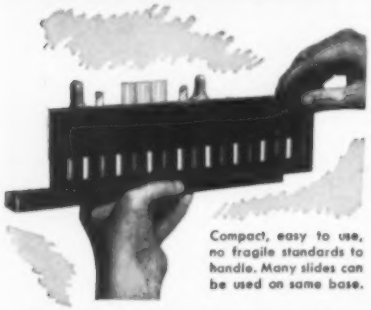

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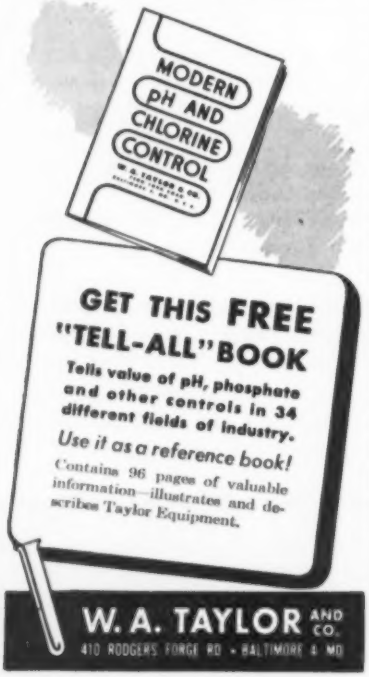
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275 **Cast Steel Valves** — This 56-pp catalog on cast steel valves includes information on globe, angle and check valves in 300, 600, 900 and 1500 lb pressure classes. Parabolic disc valves for hand or motor control of volume are also described. In addition to standard information on construction features, dimensions and weights, the booklet contains complete data on material specifications, preparation of welding ends, flange facings, and ratings. Edward Valves, Inc.

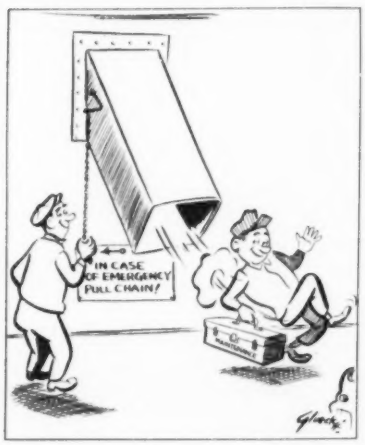
276 **Gate Valves** — Literature is available on cast steel outside-stem-and-yoke gate valves; also on bronze, iron, steel and corrosion-resisting valves in a variety of types. The Wm. Powell Co.

277 **To Get at Those Valves** — This little folder describes a sprocket rim with chain guide. The rim adjusts to fit all valve wheels. Babbitt Steam Specialty Co.

278 **For Precise Control** — Fifty-pp Catalog 17 covers manufacturer's line of disc valves and accessories, providing full selection and ordering data, materials of construction, sizes. Describes manuals and automatic controls for these valves which, it is noted, are available in any metal which can be cast or welded. Minimum pressure drop, quick closure, simplicity and other advantages of the valves are discussed. R. S. Products Corp.

279 **Regulating Valves** — Bulletin 313 describes double seated diaphragm regulating valves for use with control instruments, outlining special features of the valves, particularly the "flow line" contoured body engineered for high capacity at low pressure drop. Leslie Co.

280 **Solving Steam Trap Problems** — This 36-pp catalog on steam traps contains specifications and capacities on steam traps, float traps, air release valves and pipe line strainers. Tells how to calculate condensation loads and select traps for all classes of equipment, including unit heaters, jacketed kettles, autoclaves, submerged surfaces, steam mains and header drips. Gives pointers on how to install and service traps. The V. D. Anderson Co.



281 **Steam Trap Book** — Catalog J, 44 pp, serves as a manual of trapping practice. Includes a catalog section giving physical data and prices on cast semi-steel and forged steel inverted bucket steam traps, compound steam traps and ball float air and air relief traps; a handbook section explaining how to calculate condensate

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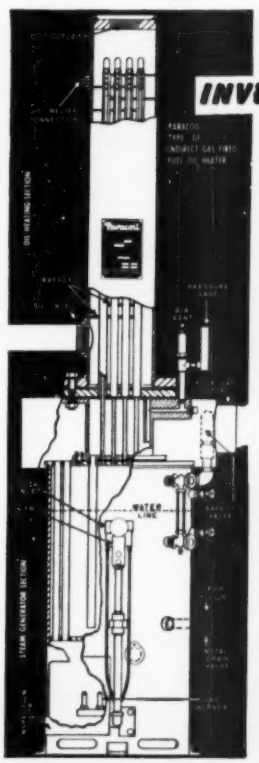

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loads and select traps for all classes of equipment; a maintenance section explaining trap installation, trouble-shooting and repair. Armstrong Machine Works.

282 Steam Trap Rerefence Manual — Bulletin T-1740, 24 pp, tells why and where steam traps should be used; explains desirable trap features. Advantages of company's impulse steam traps are described, their operation illustrated. How to figure trap sizes and how to size condensate return lines are told and capacity and pipe dimension charts and thermodynamic properties of saturated steam included. Yarnall-Waring Co.

283 Steam, Air and Gasoline Traps — Illustrated Catalog 751, 32 pp, provides capacity tables, installation diagrams and a section containing data, charts and formulas for determining proper size trap for specific applications. Covers thermostatic steam traps for pressures to 225 lb, expansion steam traps, weight-operated traps for steam, air and gasoline, also piston-operated traps. W. H. Nicholson & Co.

284 Piping Pointers — This is company's highly popular 36-pp manual covering fundamentals of sound piping practices. Discusses various types of valve designs and how each should be used. Pictures and names more than 80 fittings and contains illustrated how-to-do-it features. Includes 8-pp valve selection guide. Crane Co.

285 Unions and Fittings — Twelve-pp Catalog 50 covers manufacturer's line of unions of all types, elbows, tees and fittings. It describes and illustrates special features. Dart Union Co.

286 Handbook on Fittings, Flanges — Catalog wf-1950, 68 pp, offers working information on seamless carbon steel welding fittings and forged steel flanges. Includes dimensional tolerances, thread standards and threading practice; service pressure ratings, physical and chemical requirements. Grinnell Co., Inc.

PACKINGS, GASKETS, SEALS

287 Packings and Gaskets — Catalog P-100C, 32 pp, covers 95 most popular packings and gaskets in company's line, furnishing details of construction, service recommendations and size information. Includes charts showing specific recommendations for many applications. Packing Div., Raybestos-Manhattan, Inc.

288 Seals for Bearings — Complete information on manufacturer's Klozure oil and grease seals for bearings is available in 100-pp Catalog 10. Fully illustrated in color, pictures all types of these seals, typical applications and lists sizes and part numbers. Also describes mechanical pressure seals for rotary shafts. The Garlock Packing Co.

289 Packings for the Power Plant — Designed as a quick-reference aid, one feature of this compact 6-pp guide is a flow sheet of a rudimentary industrial power plant with each unit keyed to the proper packings and gaskets. Illustrated. Includes construction information, sizes. Johns-Manville.

290 Long Wearing Piston Packing — Form 4502, 8 pp, presents composition cups for packing pistons of air and hydraulic cylinders and reciprocating pumps. Engineering information covers properties, textures, temperature and pressure data, sizes. Darling Valve & Mfg. Co.

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291 Rotary Pump Service Manual — The installation, operation and maintenance of rotary pumps are covered in 12-pp Service Manual 100-2. Subjects discussed include installing of foundation bolts, alignment, supporting vertical pumps, grouting, piping, suction lines, hot liquid pumps, rotation, packing, dismantling, reassembly, starting, operation and standing idle. Warren Steam Pump Co.

292 Condensed Pump Data — Form 4383-J covers more than 20 types of general service pumps, rotary pumps, sump and drainage pumps, condensate units, self-priming units, stainless steel pumps and high pressure pumps. In easy-to-find tabular form, each model is pictured along with its characteristics, applications, features and references to specific literature providing further information. Goulds Pumps, Inc.

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293 Controlled Volume Pumps — Bulletin 351, 16 pp, describes company's air-powered controlled volume pumps, designed to pump practically any liquid in measured volumes accurate to within a fraction of 1 per cent. Pumps are reciprocating, positive displacement plunger types. Cross-sectionals show design and operating details. Controls and typical automatic feed systems are discussed. Milton Roy Co.

294 Boiler Feed Pump — A barrel-type boiler feed pump for high pressure, high temperature service and designed to go on the line quickly without preliminary warm-up, is the subject of 12-pp Bulletin 1525. Fully illustrated text explains automatic operation of hydraulic thrust balance incorporated in this pump. De Laval Steam Turbine Co.

295 For Controlled Volume Pumping — Bulletin 300, 24 pp, describes Pulsafeeder piston-diaphragm pumps, stressing their no-stuffing box feature and noting that although basically a pump, this unit can do the work of a feeder, meter, instrument, filling machine, proportioner and sampler. Process Equipment Div., Lapp Insulator Co., Inc.

296 Boiler Feed Pumps — Bulletin 109, 16 pp, illustrated in color, describes centrifugal pumps for boiler feed service. Pictures construction and major parts, floating seal incorporated. Capacity data and vapor pressure tables included. Pacific Pumps, Inc.

OTHER EQUIPMENT

297 Turbine Generators — Bulletin H-18, 40 pp, covers turbine generators of 500 kw and above, pictures nearly 50 turbine-generator installations, both utility and industrial. Brief discussions of generator and exciter cooling methods are in-

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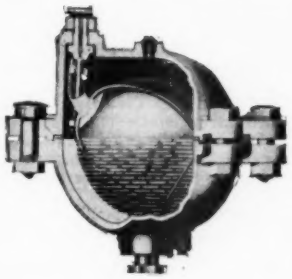

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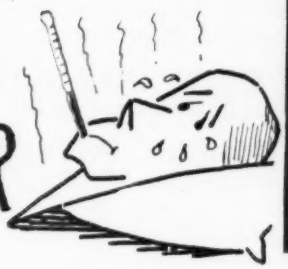

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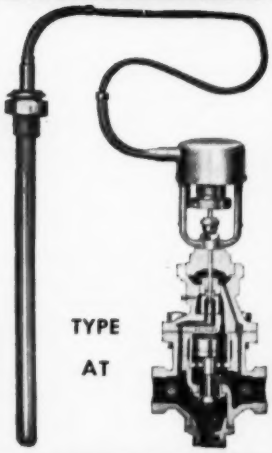

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cluded. A reference section offers detailed drawings showing a typical installation arrangement. Elliott Co.

298 Motorized Chimney Draft — The advantages of mechanical draft in supplying positive, uniform, adequate draft, regardless of variable weather conditions or inadequate chimney or breeching construction are shown in detail in Bulletin I-52. Also discusses other advantages, including eliminating need for tall stacks. L. J. Wing Mfg. Co.

299 Feedwater Heating System — This bulletin describes a flash-type deaerating feedwater heating system offering flexibility in the use of steam at different levels. The Whitlock Mfg. Co.

300 Equipment for Buildings and Institutions — Bulletin WP-1099-B27M is a 20-pp revised booklet of condensed information on sizes, dimensions, capacities, ratings and features, of a wide-range of equipment. Covers air conditioning and refrigeration products, with auxiliaries; oil, gas and dual fuel engines, deaerators and deaerating heaters; water conditionings; steam turbines and turbine generators; liquid meters; centrifugal and other pumps. Worthington Corp.

301 Hydraulic Equipment — Circular 50-A, 6 pp, describes and pictures hydraulic jacks, hydraulic high-pressure and test pumps, and hydraulic units for forcing, pressing, pulling etc. Includes application suggestions, material specifications, capacities. Richard Dudgeon Inc.

302 Water Heaters — Illustrated 6-pp Bulletin 70, Section I, on instantaneous type water heaters contains detailed capacity and dimension tables for two-, four- and six-pass designs, removable tube bundles. Davis Engineering Corp.

303 Internal Tube Cutter — This bulletin describes a time-saving pneumatic tube cutter for use on heat exchangers and condensers. Tells how it is used for cutting, trimming, serrating. Armstrong & Sons.

304 Chemical Cleaning Service — Reduced maintenance costs and outage time are among advantages of company's chemical cleaning service for steam equipment and water lines discussed in this 8-pp bulletin. Before-and-after photos show some actual cleaning jobs and several case histories are given. Dowell Inc.

305 Mechanical Draft Fans — Mechanical draft fans for both forced and induced draft service are described in 20-pp Bulletin 168. Illustrated with drawings of typical fan types and photos of installations, includes performance curves showing efficiencies of various types of fans. The Green Fuel Economizer Co., Inc.

306 Dowtherm Vaporizer — Bulletin No. 48-2, describing manufacturer's Type "A" Dowtherm Vaporizer, tells how this unit is designed to evaporate Dowtherm to provide dependable operation at maximum temperatures. The Wickes Boiler Co.

307 Ejector Instruction Manual — Bulletin J-50-7 is a 36-pp handbook covering operation, selection, installation and maintenance of steam jet air ejectors. Discusses twin and triple element ejectors, surface and jet inter- and after-condensers, isolating valves, drain traps, steam and back pressures. Foster Wheeler Corp.

308 Air Preheaters — Illustrated Bulletin A-11610, 8 pp, defines air preheat and explains its benefits in terms of increased efficiency and capacity and flame stability. Describes company's Ljungstrom preheater. The Air Preheater Corp.

Engineering Book Reviews

(*Continued from page 120*)

Compressed Air in Mining and Industry, compiled and edited by Sydney H. North; 162 pages; illustrated; size 4 by 6½ in.; cloth binding. Published by Sir Isaac Pitman & Sons, Ltd., London; distributed by Pitman Publishing Corp., 2 West 45 Street, New York 19, N. Y., 1951. Price $4.00.

Any technical book that sets out to cover a very wide field runs the risk of dealing with so many subjects that its touch on each is imperceptible. Mr. North's book suffers from this trouble. As a review of the applications of compressed air, it covers an impressive amount of ground, but the power engineer in any one of the industries mentioned probably will feel that the time and space devoted to his particular interest has been too small to justify his spending $4.00.

Another disadvantage for the American reader is the frequent reference to British practice. The occasional costs in pounds, shillings and pence, though obviously of

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little value to an American reader, are not frequent enough to destroy the usefulness of the book; the real trouble is psychological, and lies in the continual references to British practice, British machinery, and descriptions of British installations.

Technically, a compressor down a British coal mine probably behaves in much the same manner as one down an American mine, but it is just as natural for American readers to prefer their subjects illustrated with examples of American practice as it is for the English reader to like his subjects illustrated from British practice. It is not a matter of one being better than the other — both countries have lots of good information that will help the other — it's just that we prefer to read about things with which we are familiar unless the other has unusual advantages.

On the good side, there are a number of useful formulas to help engineers select the right type of equipment for particular jobs, and a number of tips often overlooked when new machines are being considered.

★ ★ ★

Diesel Engineering Handbook, Eighth Edition; 827 pages; illustrated; size 6 by 9 in., cloth binding. Published by Diesel Publications, Inc., 192 Lexington Avenue, New York 16, N. Y. Price: $7.50 U. S.; $8.50 Foreign.

Revised Eighth Edition of this handbook is a large volume, which starts with a brief treatment of the fundamental principles of diesel engine and by progressive steps carries the reader through the various elements of diesel design and construction.

The authors have covered a technical subject in terms understandable to the mechanic who frequently is not a technician.

Mathematics are employed only when necessary or desirable for clarity.

Fuel injection pumps and injection systems occupy several chapters. They are described in minute detail with specific instructions on the care and maintenance of each make and model.

The book takes on three well-defined aspects. First of these encompasses diesel plants on land, and accessories.

Second aspect is the introduction of marine subject matter. This part of the book covers elements essential to marine diesels.

Third is presentation of makes and types of diesel engines representative of various manufacturers, supplemented with tabulated specifications of all makes and models in production at time of revision.

There is a good chapter on efficiencies and economics. It is surprising, however, to find that the dual-fuel engine, to which so much attention is being given today, is given only a page under fuel injection systems. Also, the new radial diesel is given only brief discussion.

These small points, however, detract very little from this very practical and useful handbook. We recommend it heartily to all engineers and mechanics interested in the diesel engine.

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Cut Piping Costs with...

Save money! Lay out your overhead piping plan for utmost efficiency, convenience and economy — without special stairs, catwalks, balconies, or detours to floor level to bring valves within reach. Low-cost Babbitt Adjustable Sprocket Rim with Chain Guide makes every overhead valve easily accessible. Saves fuel and steam costs, too.

- **Simplifies pipe layouts**
- **Prevents accidents**
- **Fits all valve wheels**

Four simple, quickly-assembled parts quickly installed — in range of 10 adjustable sizes to fit all valve wheels from 2 to 30 inches diameter, with rising or non-rising stems.

Call your Industrial Distributor. He carries complete stocks. Or write for descriptive folder and prices.

Babbitt STEAM SPECIALTY CO.

4 BABBITT SQUARE, NEW BEDFORD, MASSACHUSETTS

For more data circle 580 on Post Card

KOR

A New Definition

FOR CLEAN BOILERS

—a noun (pronounced "core"); derived from Keeps Oil Right; an alkaline, non-acid, non-corrosive, safe to use, fast acting liquid fuel oil CONDITIONER for all grades; so processed that a small quantity will do a complete sludge-dissolving, fire-side and fuel system cleaning job which ordinary so-called treatments, additives, and sludge solvents are not processed to do; excels everything else as a combustion support in the burning of fuel oil; and nothing else is exactly like it.

MAKES MORE STEAM POSSIBLE WITH LESS FUEL
PAYS FOR ITSELF BY THE FUEL IT SAVES

Write for Prices and Free Bulletins

KOR CORPORATION

Division of Oxi Corporation

MANUFACTURING, ENGINEERING, AND COMBUSTION SPECIALISTS

600 WEST 9th AVENUE, GARY, INDIANA

For more data circle 581 on Post Card

We have the answer to your Oil Heating Problems

SUCTION TYPE TANK HEATERS

Installed at the base of bulk storage tanks, these heaters bring oil to the proper temperature for easy pumping. They heat the oil only as it is withdrawn, thus reducing radiation losses to a minimum. U-bend heating element and sheath are designed for easy installation into the storage tank by welding, riveting or bolting. Heavy gauge tubes welded to tube sheet assure long equipment life.

TYPE V-1 STANDARD OIL HEATERS

These heaters, built in four standard sizes, are maintained in stock at all times for prompt delivery. Heater incorporates straight tube bundle with tube sheet welded to shell, minimizing the number of gasketed joints. Type V-1 is designed for economy, simplicity, and ease of cleaning. No line connections need be broken to enter the tube circuit.

TYPE W OIL HEATERS

Special Whitlock expansion member compensates for differential expansion or contraction between shell and tubes. Standard sizes are designed for working pressures of 250 and 400 psi. on both shell and tube side, but can be supplied for higher pressures when required. Straight tubes facilitate cleaning.

WHITLOCK

Find out about these and other Whitlock Oil Heaters. Write for Bulletin 35A, or send specifications on your particular requirements. The Whitlock Manufacturing Company, 47 South Street, Hartford 10, Conn. In Canada: Darling Bros., Ltd., Montreal.

* * *

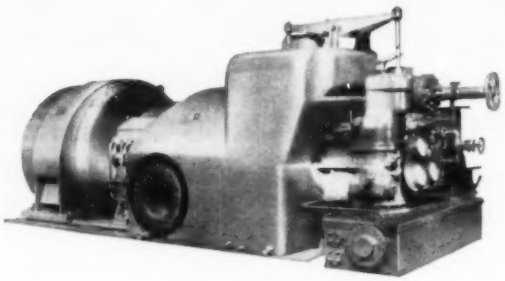
Whitlock Designs and Builds: bends, coils, condensers, coolers, heat exchangers, heaters, piping, pressure vessels, receivers, reboilers.

For more data circle 582 on Post Card

"These unique steam seals control turbine shaft leakage, lengthen seal life"

Westinghouse has perfected carbon ring glands by this ingenious two-way application of spring pressures. Two "garter" springs accurately align and support each gland around the shaft. Precisely determined tensions, compensating for the weight of the ring itself, effect a close seal *all around* the shaft without abrasion or binding. Leakage around the rings is prevented by six spring-loaded, stainless steel buttons which seal the gland face against its housing. Based upon precision mating surfaces instead of heavy spring pressure, gland rings "float" freely with natural shaft movement. For many years, this perfectly balanced spring and gland combination has proved its ability to control steam leakage along the shaft with minimum maintenance.

The greater simplicity and reliability of this gland design indicates the value of Westinghouse Engineering in steam turbine operation. Based on over 50 years' experience, this engineering contributes the many bonus features found only in Westinghouse General-Purpose Turbines. It is a basic reason why more and more power engineers are relying on "Westinghouse" when needing steam drives. Put this unequaled background to work for you by calling your local Westinghouse Office or writing Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh, Pennsylvania.



Type M General-Purpose Turbine

A single basic design with modifications for every type of service is shown here as a turbine-generator set. One of its many applications would be operation as a noncondensing unit with exhaust steam used for heating or processing. Available in ratings 1000 to 10,000 hp and 1000 to 7500 rpm, it utilizes every Westinghouse design advantage to attain exceptionally high efficiency. J-50560

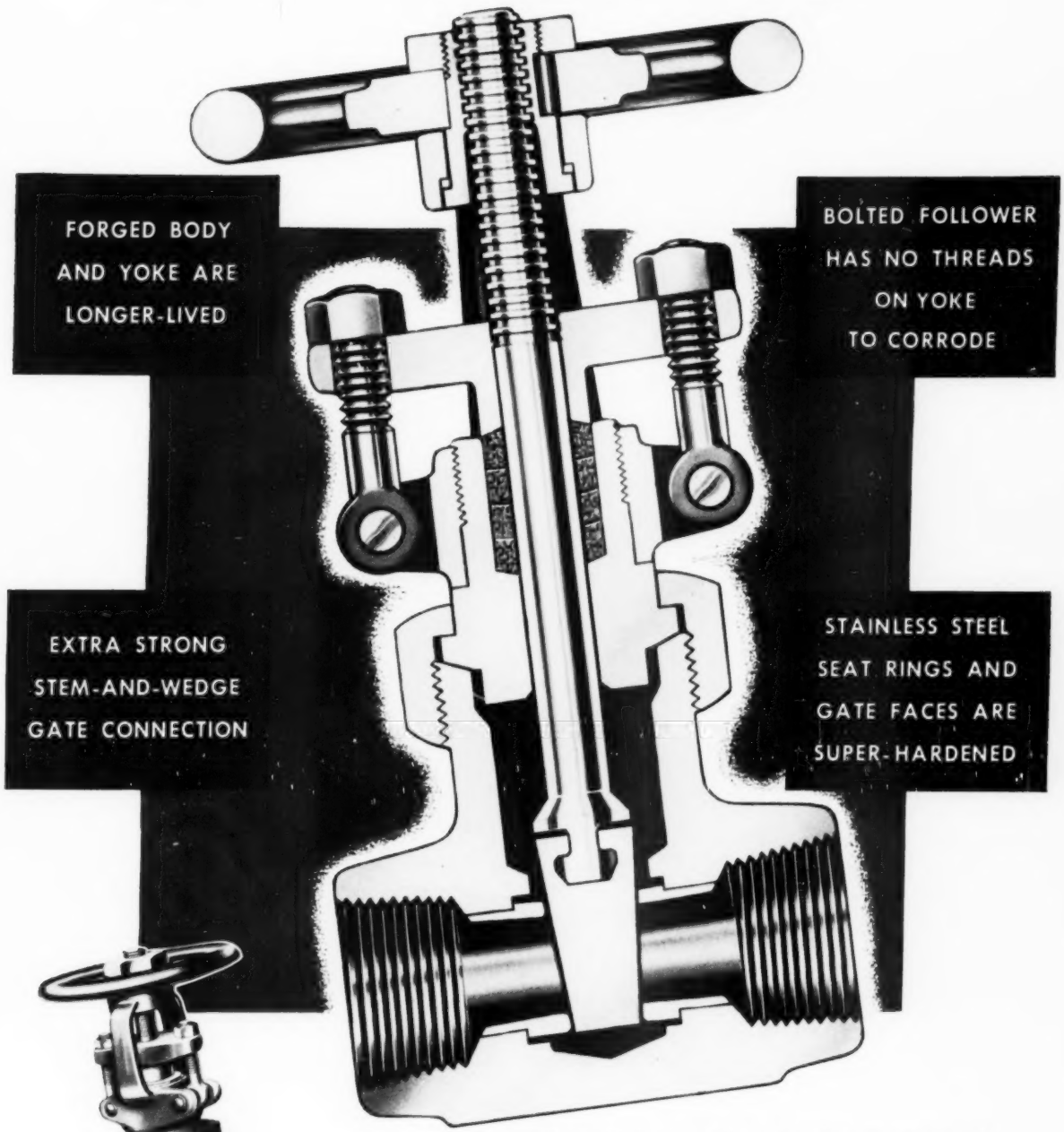
Turbines for every industrial use

YOU CAN BE **SURE**...IF IT'S

Westinghouse

For more data circle 583 on Post Card

Here's where CHAPMAN LIST 960... *gets all that Extra Strength*


FORGED BODY AND YOKE ARE LONGER-LIVED
BOLTED FOLLOWER HAS NO THREADS ON YOKE TO CORRODE
EXTRA STRONG STEM-AND-WEDGE GATE CONNECTION
STAINLESS STEEL SEAT RINGS AND GATE FACES ARE SUPER-HARDENED

These hyper-husky, small forged carbon or alloy steel gate valves come in sizes from ¼″ to 2″ inclusive... with choice of rising stem with yoke (shown), or with inside screw . . . and with choice of bonnet joints either gasketed or metal-to-metal. Pressure range: 2,000 lb. at 100°F. — 380 lb. at 1,000°F . . . if any higher, specify List 990. Send for Catalog 10.

The Chapman Valve Mfg. Co.

INDIAN ORCHARD, MASSACHUSETTS

For more data circle 584 on Post Card

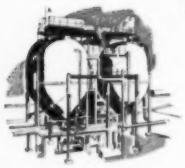
Part of Shell Oil Company's modern Houston, Texas refinery which processes 125,000 barrels of crude oil daily.

PERMUTIT
ION EXCHANGERS

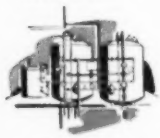
deliver highest purity makeup for

SHELL

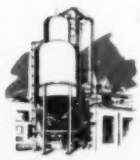
BOILERS in this enormous Shell refinery operate at 650 psi. Steam output is received by turbo-generators . . . exhausted to process. ¶ To insure continuous steam turbine operation—for greater efficiency and more economical production—Permutit Demineralizing Equipment treats makeup water. The ion exchange units at right have a continuous capacity of 96,000 gph. ¶ The raw well water supply contains high total dissolved mineral solids—324 ppm, a harmful amount of silica—13 ppm. Its total hardness is 70 ppm, methyl orange alkalinity 230 ppm. ¶ This installation—a Permutit Two-Step Demineralizer with Degasifier—removes virtually all dissolved mineral solids. Silica is reduced to under 0.2 ppm. The effluent is purer than most distilled waters, costs much less to produce. Most important, costly shut-downs from heavy scale on turbine blades are prevented. ¶ Permutit makes all types of ion exchangers and water conditioning equipment . . . can save you time and money in the specification of the one combination that best suits your needs. ¶ For aid in solving your own water problems, write to The Permutit Company, Dept. PE9, 330 West 42nd St., New York 36, N. Y. or Permutit Company of Canada, Ltd., 6975 Jeanne Mance Street, Montreal.



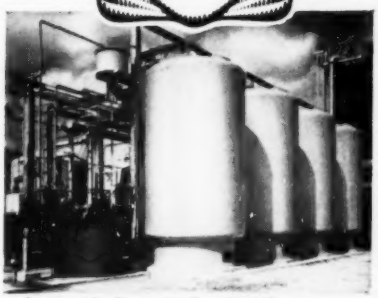
Sludge Blanket Hot Lime Soda



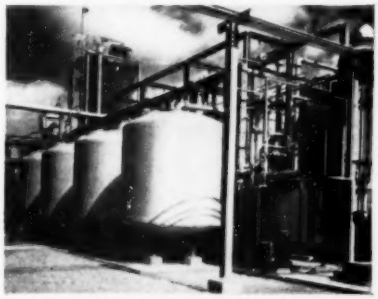
Hot Zeolite-Permutit Q



Deaerating Heater



Automatic Permutit Zeo-Karb® units remove metallic cations from Shell's well water supply. Effluent passes to Degasifier at right for low cost CO_2 reduction.



Automatic Permutit S units remove remaining troublesome mineral impurities by anion exchange.

PERMUTIT®

ION EXCHANGE AND WATER CONDITIONING HEADQUARTERS FOR OVER 40 YEARS